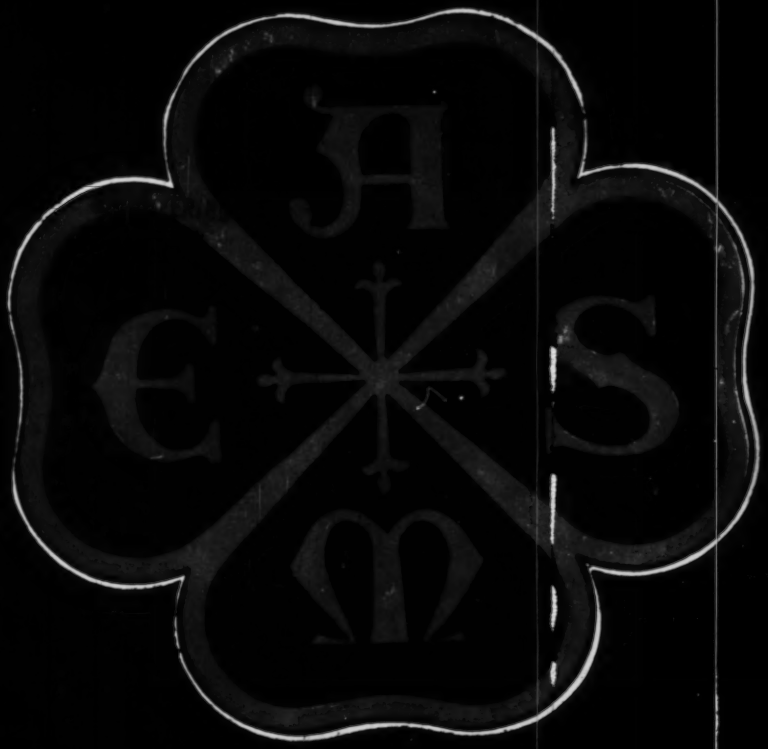
MECHANICAL ENGINEERING



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MECHANICAL ENGINEERING

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VOLUME 68 NUMBER 1

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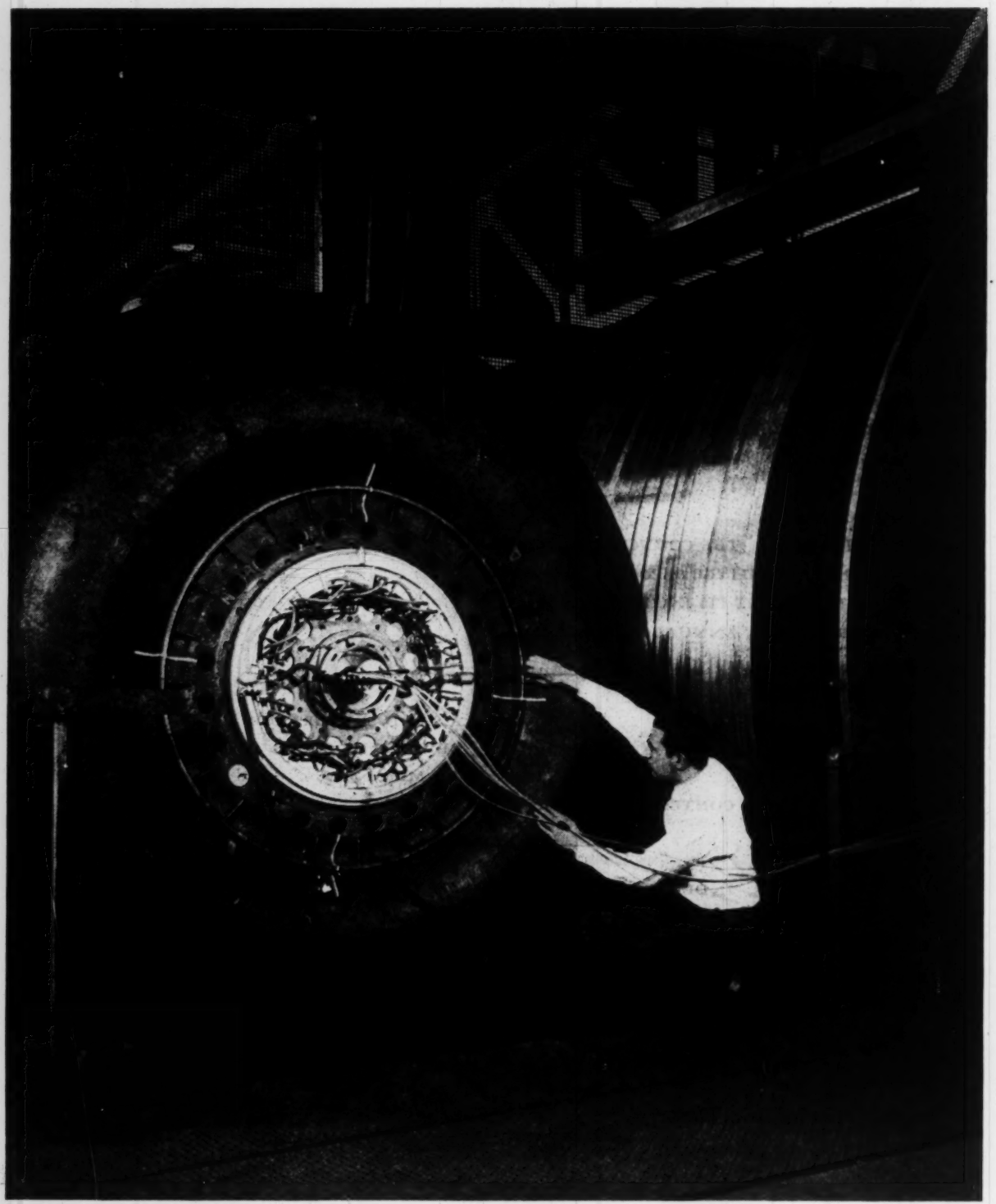

Giant Tire After Test on World's Largest Dynamometer

(The massive size of the world's largest wheel, brake, and tire-testing machine used to simulate landing effect of future giant bombers is shown being examined after test run. The three-quarter ton tire stops the 158-ton steel inertia wheel in 20 seconds. The 110-inch tire is slammed against the steel wheel as the wheel speeds around at two miles a minute, simulating actual landing conditions without risking personnel or equipment. The apparatus, designed and built by the Adamson Machine Company of Akron, Ohio, in conjunction with the Aircraft Laboratory, Engineering Division of the AAF Air Technical Service Command, is equipped with controls and motors built by the Westinghouse Electric Corporation. The Dynamometer weighs 250 tons and with it AAF engineers at Wright Field, Dayton, Ohio, check the strength and operating characteristics of new airplane landing, wheel, brake, and tire assemblies.)

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MECHANICAL ENGINEERING

JANUARY
1946

GEORGE A. STETSON, *Editor*

The Road Ahead

MANY persons who attended the 1945 Annual Meeting of The American Society of Mechanical Engineers expressed amazement at the extent and variety of the technical program. Every available period, morning, afternoon, and evening, of the four days was crowded with sessions—as many as nine were held simultaneously in one afternoon—and every session was crammed with papers and discussions. At some dinners and luncheons—there were many choices because of the number—even the speeches were on semitechnical subjects, so great was the pressure of technical material seeking expression.

There was nothing unexpected in this flood of technical papers. For years the nation had been intensively expanding its production techniques. Its engineering talent had been expended on products alien to peacetime manufacturing. A tremendous amount of design had been undertaken. Precision became the rule rather than the exception. Volume of production demanded systems of control, mechanization, and handling. Conditions dictated the use of new materials. Rates of removal of metal in cutting had been spectacularly increased. Research had been universally stimulated. More than in any previous war engineers had been called upon to exert their skills for victory. As never before the public sensed the value and importance of the engineer's contribution. With the winning of the war the time had come when engineers could plan for the reconversion of industry to the task of creating peacetime goods and for adapting what had been learned in the war to constructive uses. It was a transition period in which certain military aspects of mechanical engineering could be reported and the problems of the immediate future could be discussed. It was not strange, therefore, that a vast number of technical subjects crowded the program.

Beyond the technical program influences of far-reaching significance were sensed. It was evident, for example, that the Society's position was sound and vigorous. Its financial affairs were in excellent and prosperous condition. Its membership had grown during the war years. Its administration was alert and forward-looking, and its organization had been modified and strengthened in anticipation of meeting the needs of the immediate future. In spite of the heavy and time-consuming tasks that had been laid on officers and committeemen during the war years, long-range plans had been laid and were ready to be put into effect without loss of the momentum to carry them into the future. The means of closer and more effective relationships between the Sections and the Council had been perfected in the election of eight regional vice-presidents on whose shoulders the principal burden of developing these relationships to their fullest potentialities will fall. Surely the Society can look forward with confidence toward great achievements and an era of enlarged public service. The extent to which this confidence will be justified rests with members of the Society.

In still another area progress was noted. Through the instrumentality of the Engineers Joint Council, which is composed of the principal officers of the four Founder Societies and the American Institute of Chemical Engineers, the problems which are the common concern of engineering societies and the engineering profession are being attacked with vigor and intelligence. In the report of the Annual Meeting, which appears on pages 56–70 of this issue, a résumé of statements covering four major projects of the E.J.C. will be found. These cover a wide field—the engineers' plan for the disarmament of the aggressor nations; the views of a panel of engineers in respect to pending legislation looking toward the establishment of a National Research Foundation; the studies in progress by a Committee on Society Organization on methods by which the engineering profession may establish a united front; and the plans of the Committee on the Economic Status of the Engineer on earnings and the relationship of engineers and their employers.

It is becoming increasingly apparent that the progress of engineering achievements arises from many sources, is urged forward by strong pressures, and holds the promise of rich rewards in service to humanity and satisfactions for those who take part in it. The problems such progress poses are not so much those of stimulation as they are, to a growing extent, those of control, correlation, and direction. The postwar world and the position of leadership in it which the United States seems fated to assume, elevate engineering progress to a role of one of the principal factors in the maintenance of international peace and of the prosperity of our own people, which must spread rapidly to the entire world. With our own security established we shall be in a favorable position to establish the security of the rest of the world.

These vital objectives cannot be attained by indifference, by resting on our laurels, and by policies that are individually and nationally selfish. The public interest, national and international, is at stake. Hence direction,

correlation, and control of our activities become essential. Vigorous engineering societies and a united engineering profession will be powerful factors in building a better world. Committees of such societies afford the means by which the work of individuals becomes effective and is clothed with authority. Unification and joint action of these societies is another essential step in this same direction. Successful as the joint activities of a number of engineering societies have been, the goal of bringing together all engineering societies should be more earnestly sought. Progress is being made, but much remains to be accomplished. The stakes are too high to risk dissension and frustration born of petty jealousies and motives. The responsibility falls not alone on leaders; it extends to the individual and the rank and file upon whom the leaders must rely and to whose constructive opinions they must be responsive.

Reflection on the 1945 A.S.M.E. Annual Meeting engenders optimism. The opportunity for great achievements was never brighter. The Society was never in better condition to make the most of these opportunities. And, best of all, there never was a time in which the will to accomplish great things was so thoroughly permeated with the spirit of co-operation and service. The road ahead is difficult, but it leads to a goal every right-thinking engineer will wish to attain.

New Abstract Quarterly

IT IS a pleasure to welcome a new engineering quarterly, *Refrigeration Abstracts*, to commend it to engineers, and to congratulate the American Society of Refrigerating Engineers on its enterprise in providing a valuable service to its engineers interested in refrigeration.

This new abstract service was initiated as a result of a demand for sources of information in the field of refrigeration. The extent of the subject matter and the great number of sources in this country and overseas necessitate a tremendous amount of time and effort on the part of the individual seeking information. Few persons have easy access to libraries completely stocked with technical periodicals. Specific problems may force the searchers to undertake a painstaking review of all available literature and the time and effort thus expended can usually be justified by the results. When it comes to current literature, however, the busy man must confine himself to a relatively few journals. What is published in the periodicals he does not normally see is likely to escape his notice until he learns about it by accident or because the pressing need of running down a specific subject drives him to it. An abstract service, if its coverage is essentially complete, if it is adequately classified, if it is reasonably up to date, and if it is conducted by persons familiar with the subject matter, provides a busy engineer with a cheap and simple means of keeping abreast of the times, and a valuable series of references to information that may later be needed on short notice. These features are provided in the new A.S.R.E. publication.

Eleven classes of abstracts are to be found in the new quarterly and a list of these classes will serve to indicate the scope of the service. They are: General, natural sciences, engineering, engineering materials, refrigerating media, thermal insulating materials, machinery and equipment, foods, refrigerating applications, codes, standards, and laws, and patents.

The abstracts themselves vary in length from a single sentence to several hundred words. It is apparent that the writers of these abstracts have attempted to do more than to state what the article is about; where possible, sufficient information is provided to give the reader a basis for forming his own opinion of the value of the article to him; conclusions are frequently quoted or summarized, and specific statements leave the reader with the feeling that he has increased his knowledge of the subject treated. A list of periodical references is included, and it is stated that about 300 American and British periodicals, in addition to United States patents, are being searched for abstracts. It is gratifying to notice the publications of the A.S.M.E. in the list and the abstracts of many A.S.M.E. papers in the initial issue of the quarterly.

Preparation of the abstracts is under the direction of J. Mack Tucker, of the University of Tennessee, a member of A.S.M.E. A staff of approximately 60 abstracters is listed and each abstract carries the name of the abstracter. The painstaking work of Professor Tucker and his staff deserves commendation and support.

Choosing a Career

CHOOSING a career in one of the professions calls for an objectivity and method of self-analysis few young persons can develop without assistance. The fact that thousands of men succeed in their careers blinds us to the thousands of false starts and mistakes which might have been avoided in many cases. Trial and error are effective, but they impose a stern discipline and sometimes lead to futility and frustration. The technique of self-analysis is composed of so much that is obvious, when stated, that disappointment may await those who look for the easy, the spectacular, or even the magical formula. Nor is adoption of a sound technique a guarantee of success, human nature being what it is. We can only hope that by making a good technique available to a young man he will apply it conscientiously and that the number of mistakes and false starts will be lessened.

To meet the needs of young servicemen as well as those still in college or even those just embarked on their chosen careers Elliott Dunlap Smith has prepared an article for this issue, pages 27–32, which should prove helpful in self-analysis and in directed-guidance work. It warrants thoughtful and frequent reading by returning servicemen of professional caliber, by students, by young engineers, and by counselors of these young persons. Even older engineers will find it helpful and suggestive.

VICTORY THROUGH AIR POWER

By LIEUT. GEN. IRA C. EAKER

DEPUTY COMMANDER, ARMY AIR FORCES

EARLY this month General Arnold's report to the Secretary of War on recent developments in the Army Air Forces was released to the press. It had hardly had time to reach the desks of the Washington editors when a phone call was received asking if there was any objection to including a little dictionary with the story of the report in order to explain the terms. "Our readers," the editor said, "will have to have a little help on pulsojet, turbofan, turbojet, and a few other similar words."

It is not necessary for us to elaborate on what is obvious to all—science's progress in the last few years has been incredible.

There have been times, I will admit, when the engineers and designers have gotten a little under my skin. When I was in England with the Eighth Air Force a young scientifically inclined colonel came from the Materiel Division at Wright Field to visit our units. He brought along two civilian engineers representing an airplane company and an engine company. A few days after they had gone to the Midlands to visit the units and to observe operations at firsthand, I received a phone call from one of the division commanders whose tone inferred that all was not well. "These engineers you sent down here are telling my boys that they should see the new airplanes that are going to come out in quantity next year with new nose turrets, protected waist positions, better heaters, much more armor plate, and far better flying characteristics," he said. I replied that all engineers talked that way. "Well, maybe so, General," the division commander replied, "but some of my boys wonder if it is all right with you to put aside this order we just received to attack Hamburg tomorrow and wait until the new airplanes arrive."

During the war one of our best sources of intelligence was a study of statements made by captured Germans. Toward the end as the high-ranking generals started to fall into our hands I instructed our Intelligence Staffs to ask these German leaders to explain the reasons for Germany's defeat.

GERMANS LOST TECHNICAL SUPERIORITY

Here is what Field Marshal Keitel, Chief of the High Command, said on this subject: "We had dropped back in technical achievements. We had not preserved our technical superiority." It should be pointed out that Keitel was responsible directly to Hitler for the co-ordination of the three military services. He was probably the best informed of Germany's military men.

Now why hadn't Germany kept pace technically? We all know that she had a running start on the other nations.

I believe that the reason was that she had discarded the carefully organized meetings of scientific men, pushed aside such deliberations as being out of date. Her strategic and tactical doctrines, her operational plans, were not hammered out realistically by competent military and scientific advisers working together. Germany turned to miracle men who with hardly a pause gave quick decisions on such matters as the operational use of radar, development of jet aircraft, and many other similar and highly complicated subjects. If there were any bold enough to dispute these arbitrary decisions, the Secret Police were ready to whisk the disbelievers away to the concentration camps.

There is an intimate and vital relationship between engineers and the fighting men at the front which must continue after war has broken out if success is to be insured.

Air superiority sometimes hangs by a slender thread.

INDUSTRY ABSORBED AIRCRAFT CHANGES RAPIDLY

Our first B-17 aircraft were hardly back from their first missions before our operational-analysis and materiel specialists started sending back to the United States a steady flow of change orders and suggestions for major modifications. The speed with which industry produced under these changes amazed all of us in England. There are men in this audience, I am sure, who looked with little enthusiasm on the long list of changes that kept coming through just as their production lines started to move. But I tell you with great sincerity that I feel it might well have been disastrous if we had not had that close and intimate relationship between you engineers and designers and production men at home, and the fighting men who flew our aircraft in combat.

I said that the Germans did not recognize the importance of this. Let me give you an example and you will see that it works both ways. They developed a new airplane in 1943, the Messerschmitt 262. It was one of the first jet airplanes to be suited for operational flying. When two of our returning pilots told me that they had observed the ship in the air and that it had four cannons and could fly 500 miles an hour I was worried, very worried indeed. I sent for a number of our technical people and we started a series of conferences on countermeasures that might be developed if the Germans started to employ this plane in large numbers against us. We were then planning a series of attacks on German aircraft factories designed to insure our control of the air and we were already laying preliminary plans for the attacks against fuel and transportation. We could not afford to have the pace of our assaults slowed. As the days passed and our Intelligence Staffs told us that No. 262 production was up and that we could anticipate heavy attacks, a very strange thing happened. The No. 262 didn't appear at all for a few days. Then they became inconsistent. They would fly for a few days and then we would not see them. We took advantage of the situation and pressed home some attacks on installations of importance to No. 262 production. From then to the end of the war we never encountered No. 262's in the numbers we had anticipated.

From recent information that has just become available, here apparently is what happened. The airplane was designed and built as a fighter. It had fuel for only a little more than an hour. It had very little bomb-carrying capacity. And there was no bombsight available to use at the speeds at which the No. 262 flew. But the High Command was anxious to launch a series of bombing attacks. Apparently they had not taken the engineers into their confidence. When the plan to attack was decided upon they passed it down to the operational units equipped with 262's. There were a few very quiet protests

An address delivered at the Annual Banquet during the Annual Meeting, New York, N. Y., Nov. 26–29, 1945, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

and the No. 262 without bombsight and without much range become a bomber. That is what I mean when I say that the Germans had an unrealistic concept of modern war, as far as the air war was concerned. For they did not cement the partnership between engineering, production, and operations. Warfare has become far too complicated to neglect this relationship. Let us never forget that fact.

Most of you, I am sure, are familiar with the principal German weapons. That these were not replaced, or at least materially improved during the course of the war indicates, as I have pointed out, a glaring weakness on the part of the German Command and its scientific advisers.

Perhaps no omission is as clearly illustrative of this point as the German failure to develop a good four-engine bombardment airplane. An entire talk might be made on this subject.

Admiral Doenitz of the German Navy repeatedly asked the High Command to give him a long-range four-engine plane to assist in the U-boat campaign, specifically to aid in reconnaissance and in spotting convoys, and also to present a challenge to Allied aircraft then patrolling the Atlantic. And the German commanders charged with carrying out bombing operations had asked for four-engine planes capable of carrying larger loads and equipped with better ordnance and navigation equipment. But modern four-engine equipment was not forthcoming. At the very end of the war our pilots flying against the last of the German airdromes deep in Germany came back with reports and photographs that the same old JU88's, Dornier 217's, and Heinkel 111's were on the fields. The story about a powerful strategic bombing force proved to be a myth.

There was one novel device developed by the Germans which, among other things, indicates how sensitive they were to our bombing attacks and to what ends they tried to go to prevent us from carrying out these missions.

You will recall that the Germans had built submarine pens on the Bay of Biscay. They had constructed a number of great garages to house their U-boats when they were in port under repair. These pens were very heavily constructed and our attempts to bomb them had met with only limited success. The entrance to these pens was open and presented an interesting possibility which was apparent to us as well as to the Germans.

UNDERWATER MINES USED TO PROTECT SUBMARINE PENS

To protect against the obvious threat of low-flying airplanes which might attempt to skip-bomb the pens, the Germans carried out an exhaustive series of experiments with underwater mines. These were arranged to detonate through a remote-control device. The resulting explosion would throw up a column of water to a height of 1000 feet. These great spouts were reported to be 200 feet in thickness. Tests convinced the Germans that a flight of three-low-flying aircraft operating against these pens could have been destroyed by one of these geysers of water.

Toward the end of the war we captured the German who had stood watch for many months with his finger on the button waiting to set off the mines. He was a disappointed man and asked why we never attacked the pens. He said, "Your Intelligence must have been very good. We tried to keep the mines a great secret." As a matter of fact our aerial photographs had shown us little evidence of these great mines but we had seen a string of cable across the front of the pens which had discouraged any interest in low-flying attacks.

I mentioned Admiral Doenitz and the U-boat campaign. You can be sure that those of us that went to England early in 1942 followed the rate of sinkings with the greatest interest. The U-boat at that time was master of the Atlantic and, among other things, presented a really serious threat to the build-up of strength that we had planned for the Eighth Air Force. When Admiral Doenitz was captured he was asked what it was that caused the severe fall in U-boat sinkings. He replied without hesitation, "Radar." He stated that the climax in the submarine surface was reached in March or April of 1943. "At that time," Doenitz said, "we suffered a sharp reverse from which we never again recovered. This was caused by the Anglo-American Air Forces, with its improved radio location equipment. From then on, the submarines on the surface were detected and your planes could both fight them and notify and divert your convoys. As a countermeasure we attempted to develop the *Schernechel*, an air mast which enabled the submarines to stay under the water and breathe, but this came too late."

JAPANESE WITHOUT EFFECTIVE RADAR EQUIPMENT

Asked what he thought the Japanese might have in the line of radio location the Admiral made this revealing answer: "I believe that they have little or nothing at all. The development is probably just as bad as it was with us. Our main trouble was that we could not build radar equipment for short wave."

During the war, I think it is fair to say that the overseas commanders asked for the impossible from industry and frequently got it. We were not merely content to send back a stream of change orders to the United States. The Air Force personnel overseas and those at home wanted a complete new line of aircraft. I see familiar faces in this audience, men who are well acquainted with this progress. I am sure that one of the most brilliant engineering and manufacturing achievements of our times was the development and introduction into combat of the B-29. With a tremendous amount of American industry committed to manufacturing B-17 and B-24 bombers the Air Forces set up an entirely new bomber program for the B-29. The production men who made this airplane a reality are, in my opinion, entitled to the grateful thanks of this nation. For without the B-29 the war in the Far East might have been stretched out for months with highly costly amphibious operations against fixed positions. In addition to the B-29, there were several other airplanes whose names will not be so familiar to you. These are the planes that missed the war. The project engineers were pushing them hard but they ran out of time. The sudden cessation of hostilities barred the entry of these ships into combat. These included the following A.A.F. types: Lockheed's P-80A, the "shooting star," a jet-propelled fighter; Consolidated Vultee's XP-81, the fighter with gas turbine for propeller drive in the nose, and turbojet in the tail; and North American's double "mustang" fighter, the P-82. The Royal Air Force had its de Haviland Hornet long-range fighter, smaller and faster version of the well-known Mosquito.

400-MPH BOMBERS DEVELOPED

Prolonged fighting would also have permitted Britain's big Lincoln Bomber (an enlarged version of the Lancaster), to throw its not inconsiderable weight into the picture, and a really long Pacific war would have seen the advent of such long-range superbombers as Northrop's XB-35 Flying Wing and the gigantic XB-36. The Douglas XB-42, sometimes called the Mixmaster, first of the 400-mph bombers, might very well have seen action within a year.

A word about the future. Wars are fought today not solely by ground, naval, and air forces but by all citizens unified in a joint effort which touches every phase of national and private

(*Continued on page 32*)

TRAINING FOR LEADERSHIP

By GENERAL JACOB L. DEVERS

COMMANDING GENERAL, ARMY GROUND FORCES, WASHINGTON, D. C.

Those of you who are on the faculties of universities must redouble your efforts to develop *leaders*—as well as engineers. I mean leaders in the widest sense of the word—men who are active citizens, active heads of families, men who participate fully in the civic, welfare, and educational activities of the community.

Those of you who are members of research groups, those of you who guide the search for greater knowledge, must make men and women about you realize that scientific knowledge is a cold deadly thing—unless it is animated by a close awareness of the humanities.

Those of you who are in industry have a fine chance to assist in the training for leadership of your employees, especially men who are climbing the ladder as supervisors and foremen.

AFTER reading over the distinguished guest list and looking at your impressive program, I am a bit frightened at the thought that I can tell you anything.

Men who can discuss such subjects as "Free Heat Convection Through Enclosed Plane Gas Layers," or "Creep of Neoprene in Shear Under Static Conditions," must know almost everything.

As one of the enlisted men in my headquarters said, "Even a first sergeant couldn't tell these people anything."

This was such good advice I couldn't resist taking it. So, this afternoon instead of trying to *tell* you, I'm going to throw out a few ideas and thank you on behalf of the Army Ground Forces for your splendid contribution to victory.

The subject, strictly speaking, is "Training for Leadership." Obviously that is a broad subject.

One phase of it is of particular interest to the Army—that is, training for leadership as it affects our national security.

Certain traits of the American character make following leadership very difficult for the men in our Army. We have had to plan our training and tactics to suit the American spirit of freedom and independence.

As soon as he reaches his teens, the average American has to be shown before he can be led—even when being a follower is as vital as being a leader. As a matter of fact, the average American never does become completely a follower, because he always displays strong tendencies to strike out on his own.

That is why the American soldier was self-sufficient under most circumstances. He was not at the mercy of the enemy just because he lost touch with his corporal, sergeant, or officer.

It was this spirit of self-leadership that so baffled the Germans. Many German troops were completely lost without their officers.

What there is about the atmosphere of America that seems to develop this spirit of independence is a matter of conjecture. But it is a definite fact, and anyone who disregards it is bound to run into trouble.

SPIRIT OF INDEPENDENCE MAKES LEADERSHIP DIFFICULT

This spirit of independence makes leadership a stubborn task. Everybody wants to be a leader. We all can't be. We all recognize that in our complex society, top leadership, recognized as such, is a vital necessity.

National security is one place where some must be leaders and some followers. Industry-labor relations is another. Government is a third.

The crux of the whole matter seems to be to establish just enough leadership to accomplish the objective, without offending the American sense of independence and without infringing upon the right of freedom of action that every American considers sacred.

Because of the urgent necessity for such a relationship in the Armed Forces, regulations definitely prescribe the limits, rights, and duties of both leaders and followers. They are a matter of life and death in wartime.

Since these conditions are peculiar to the Armed Forces in time of war, and are repugnant to the average American under any other circumstances, the problem of leadership outside the Army and during peacetime becomes extremely difficult.

So far it is not even near solution.

We see this every day in the friction over settlement of international and domestic problems.

Does the fault lie with our leaders, that they are unable to command the influence necessary to settle these problems without friction?

That's a question for you.

Or does the fault lie in our inheritance of a birthright of freedom that constantly borders on the revolutionary?

Or is it a natural accompaniment of depression, war, amazing scientific discovery, and personal confusion?

Perhaps the kernel of the matter is that a little bit of all these factors adds up to a whole lot of trouble.

Sometimes we think that it would be very nice if people would just obey orders exactly. Then they could be moved like chessmen. Or if they could be depended on as strictly as a scientific formula, we would always know the outcome.

But God didn't create man that way.

AMERICANS OPERATE ON BELIEF THEY ARE FREE AND EQUAL

In this country, at least, we operate on the belief that all men are created free and equal. We are constantly faced with departures from the norm, brought about by that spirit of freedom.

The problem is being solved to a certain extent every day, both in our Armed Forces and in our civilian relationships.

A partial solution may be all we'll ever get—or should get.

But we've got to get more of a solution than we have so far.

An interesting question is always propounded in every discussion of leadership; that is: Can you really train a man to be a leader, or is he born that way?

Suppose we state the qualities of leadership to be intelligence, knowledge, initiative, a forceful personality, integrity, excellent personal appearance, and strong character.

We suspect intelligence to be a matter of inheritance and environmental conditioning. Knowledge is education and

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training. Initiative can be developed, given intelligence and good health. A forceful personality can be inculcated by training and example. The same applies to integrity.

Character can be developed if the basic stuff is there. Personal appearance, except for accident, is a matter of dress and grooming. Again training.

Having all these qualities, do we necessarily have a leader? It depends on circumstances.

Leadership is not a static thing. It must be active. It must attempt accomplishment. It must have a following.

Except as parents, those who are charged with training do not come in contact with their trainees until often it is too late.

These youths have already spent 18 to 22 years in an environment over which we have had very little control. Too often we find them equipped with intelligence that has been blunted by flaws in our educational system and our informational media.

Their knowledge is sketchy. In many cases they not only lack learning, but they don't even know the mechanical processes of how to learn.

Their initiative may be suffering from a bad case of what I call "trigger-happiness." More about trigger-happiness later.

Their health may be barely adequate. Poor diet, lack of proper medical attention, dental deficiencies, and other defects cannot produce leaders. These cannot even produce capable followers, as shown by the startling and tragic figures of National Selective Service.

As of February, 1945, 22 million men between the ages of 18 and 38 had registered for the draft. Our Armed Forces consisted of approximately eleven million men. But Selective Service was compelled to reject four and one-half million Americans, or almost half as many as were accepted, because of physical defects.

These figures may not be startling to those who are trigger-happy. But they scare every leader in this country.

We all see deficiencies in personality, integrity, and character in too many of our youngsters.

Where does the fault lie?

That's another question you can answer.

Fortunately the mind and personality at ages 18 to 22 and possibly to 30 are not yet so hardened that they may not be forged in the lines of leadership—*if* the training is properly conceived and carried out. But it often is not.

Training has been the duty of our homes, high schools, and universities. Industry also plays a part in that field.

Some feel that the military wants to make an ***intrusion*** into it.

TRIGGER-HAPPY PEOPLE

Which brings me to the explanation of trigger-happiness.

Trigger-happiness is a state of mind in which the individual is convinced that we are in a new era, an era in which one merely pulls a trigger to accomplish *anything*.

No more work; no more effort. Science and the atom have seen to that.

We pull a trigger, or push a button, and a talking color movie educates us. No need for study any more.

No need for an army. We'll just pull triggers or twist dials and radio-radar-rocket-atom devices will destroy the enemy.

Life in the new era has been fully described in high-powered words and drawings in our Sunday magazine sections. As they picture it, this life is barely less wonderful than a superman comic.

At the risk of being branded a brass-bound brass hat, I say "bunk!"

And if anybody thinks that radio-radar-rocket-atom devices are going to defend this country without our blood being shed, I say, "bunk" again.

We will develop things probably as good or better than any other people in the world. But unless we learn how to make every nation in the world forget the word "aggression"—we may wake up some morning to find that somebody got in the first licks at us—much to our sorrow.

We are a natural target for attack. We sit up big and bold as the nation that twice in the last 30 years has stopped aggressors.

Do you think anybody will even dream about aggression without realizing he must knock us out first and fast?

Yes—we may develop the ultimate in protective devices. Our engineers, you people sitting here, will be the best judge of that.

The sort of thinking that blots out the actual realities of life for a trigger-happiness philosophy is a big stumbling block toward training for leadership.

It is escapism turned scientific with a vengeance. It coats a dream world with a veneer of science based on misunderstanding.

The day when everything will be done by pulling triggers has not arrived. Perhaps it is best for mankind if that day never fully comes.

The unleashing of the vast energies of the atom has, in reality, not opened a new world at all. It is the same old world, slightly awed by what it has done, a bit worried, but not too impressed, as you can see by the front pages of today's newspapers.

People still come home late for dinner, run around with other people's wives, go on strike, or kill each other. They also work hard, sacrifice for their children, and give their lives for their fellows.

We are in a world in which training for leadership is most important. We are in a world in which man has not changed fundamentally.

His science has advanced, leaving him toddling behind, bewildered, a little scared, maybe, inclined to say: "Well, what will they think of next!"

So he sits back and waits to see.

Or he says, "We've got the secret of the atom. Who knows? Maybe we won't have to dig coal, or trenches anymore."

The complexities of our problems have grown by piling unsolved human equations upon still more unsolved human equations. This brought on the war which we have just ended by destroying our enemies.

Unfortunately, in destroying these enemies, we did not destroy the human problems. Even the atom bomb wasn't big enough for that. The problems that led to war in the past, are the same today—more complex and bigger.

Apparently we cannot look to bigger and better atom bombs to solve our problems unless we mean to make one so big that it will wipe out the entire earth, and our problems with it.

Only the development of man himself to atom-level science can solve these problems.

LEADERSHIP AS AN INSPIRATION

That takes leadership of the highest type. Not just leadership to give orders, but leadership to inspire because it convinces by reasoning and facts that the projected course *is* right.

How can we train the leaders we need?

As citizens you engineers will have to take a hand. This thought was expressed in the November issue of your magazine, MECHANICAL ENGINEERING.

Those of you who are on the faculties of universities must redouble your efforts to develop *leaders*—as well as engineers.

YOUNG ENGINEERS MADE GOOD WARTIME LEADERS

We found that the very qualities of leadership that made these young men good prospects for engineers made them excellent leaders on the battlefield. And the winning of the war rose above all other considerations.

Now that we are tackling the problem of national security on a peacetime basis, the situation is far different. We believe military training to be necessary to that security, at least until we are sure peace is here to stay.

We do not believe that a year of military training will harm the professions, because we believe that year will add to, rather than detract from professional training.

The training of the individual soldier as a basic replacement takes about 17 weeks. But to train him as a useful member of a team, a division, corps, or army takes at least a year. Specialized training in such subjects as radio, radar, gunnery mathematics, tank mechanics, bridge construction, and many others is a matter of many months. This specialized training is necessary and sound. It is useful as a foundation for further training and study in the civilian world.

That is why the Army does not think a year of service for our young people is a wasted year. It should hasten the development of a sound healthy body. It should develop a mind that is disciplined to think in an orderly manner. It should bring judgment that bases its decisions on facts rather than on fancy.

The actual chance for trainees to exercise leadership in the Army is much greater than anything our schools offer freshman students at the present. Young men in the Army mix with all classes and types.

They learn tolerance because they find that race, creed, and color have no differences when it comes to basic principles. They learn self-discipline because they find that they can't keep up if they drink or play to excess. They learn poise. They can take care of themselves.

The youngster who would amount to something if he spent that year in college gains rather than loses by that year in the Army. The youngster who would have played rather than studied in college also gains, because the Army cannot afford to be so lax in its discipline.

Broadened by this experience, sobered by actual contact with life away from home, benefited by the guidance offered by the Army, the average youngster should make a better student.

In fact, he should be able to complete his professional training in less time because he knows how to buckle down to work.

ARMY TO ENCOURAGE ENGINEERING STUDY

It is obviously to the Army's advantage, to have trained professional men cognizant of the problems of defense, and to encourage engineering study.

At the same time, our main mission is the security of this nation. How to compromise these two positions is a problem that must be faced by this nation.

We cannot afford to relax into trigger-happiness and fail to train the men needed to lend weight to our voice in world councils for peace.

We cannot afford to unlearn the lessons taught so tragically at Pearl Harbor. "Remember Pearl Harbor" may have become "old stuff" as a slogan, but it should be a continuing reminder that we were once again caught unprepared, weak, virtually defenseless. The war was far more costly in lives, money, and materiel because we neglected our security after 1918.

Those of us in the military have a direct responsibility to do our best to see that Pearl Harbor is not transformed to New York Harbor in the future.

General Marshall, in his most recent biennial report, said: "To those who fear the Army might militarize our young men, and indoctrinate them with dangerous conceptions—to those who express doubts of the Army's capacity to do the job—I submit the evidence of our present armies. The troops have been trained sufficiently to defeat a first-class enemy. Their minds have not been warped—quite to the contrary. The American people are satisfied, I am confident, that their armies are, in fact, Armies of Democracy."

General Marshall went on to say: "To those who consider the introduction of a system of universal military training an imposition on Democracy, I would reply, that in my opinion, it would be the most democratic expression of our national life."

He closed by quoting from George Washington's Message to Congress of Dec. 3, 1793, the following passage:

"I cannot recommend to your notice, measures for the fulfillment of our duties to the rest of the world, without again pressing upon you the necessity of placing ourselves in a position of complete defense. There is a rank due to the United States among nations, which will be withheld . . . . if not absolutely lost, by the reputation of weakness—if we desire to avoid insult we must be ready to repel it: If we desire to secure peace. . . . . it must be known that we are at all times ready for war."

GENERAL EISENHOWER'S RECOMMENDATIONS

General Eisenhower has written the House Postwar Military Policy Committee, that large numbers of men, trained in peace, but available for quick mobilization, are vital to national security.

I quote from his letter: "There would no longer seem to be any reason for arguing the need for numbers in war. In a serious war, the quicker the maximum potential can be converted into tactical power, the surer the victory and the less the cost."

Everybody agrees that we should be strong. Very few agree on how this is to be done. Is it to be done with machines alone? Well, we thought the last war would be a mechanized one. We were fooled. A lot of men, who thought they would ride to victory in planes and tanks, found they had to crawl to victory on their stomachs.

I am sensitive to the feeling of every American against war. It is unfortunate that sometimes this feeling is carried over to the Armed Services. Tolerated in war as a necessary evil, the Services are to be done away with as quickly as possible after victory.

No mother or father wants a son sent overseas on occupation duty. The professions want bright young men to go to school, instead of to the Army.

All understandable and worthy views.

Yet we all are troubled by world conditions. We admit the need for powerful security forces.

Where are these forces coming from, if not from our young men?

I believe the Army can be trusted with these young men, because it continues to be a citizen-army. It is under constant scrutiny of our Congress and our people.

The fact that a young man has served his country, has fulfilled the obligations of citizenship, can be a vital part of his training for leadership.

I see it is time for me to stop. Once again I want to thank the Society for its valuable contribution to victory, and for this opportunity to present my views on Training for Leadership.

I mean leaders in the widest sense of the word—men who are active citizens, active heads of families, men who participate fully in the civic, welfare, and educational activities of the community.

Those of you who are members of research groups, those of you who guide the search for greater knowledge, must make men and women about you realize that scientific knowledge is a cold deadly thing—unless it is animated by a close awareness of the humanities.

Those of you who are in industry have a fine chance to assist in the training for leadership of your employees, especially men who are climbing up the ladder as supervisors and foremen.

Discipline as well as leadership should be considered.

Only by teaching that discipline does not mean subservience can we attain the true meaning of leadership. We have found that to be so in the Army.

Discipline is too often confused with blind obedience. It actually means nothing of the sort. In the Army, by "discipline," we mean "trained to effectiveness." It is reasoned obedience, through understanding why orders must be followed. It is good manners.

We have not always accomplished our objectives in the Army. In wartime we were often too busy fighting to stop long enough to bring home the lessons of leadership.

In peacetime we are forced to battle public apathy, indifference, and neglect so that the highest type of leadership is not always available in the necessary numbers.

We admit that we do not know everything there is to know about training. We need help and need it badly.

Our aim is a good one. It is the security of this nation.

There is some disagreement over the best way to accomplish this. Your co-operation in peace, as in war, is vital to our success.

NATIONAL SECURITY A DUTY OF EVERY CITIZEN

Security through trained and disciplined men is not alone the duty of the Armed Forces. National security is the obligation of every citizen; it is the responsibility of every leader, whether he be soldier, preacher, teacher, or engineer.

Do not let little incidents, exaggerated in the telling, blind you to the fact. This Army is yours—made up of your sons; its virtues are yours. Its faults are your faults, too.

The big problem of training in the Army is that of numbers. Because we had so many men to train in so little time, we could not take too much account of individuals. We were forced to adopt training methods and practices that attained the best results on the average.

From those who made the best showings in tests and in basic training we tried to pick the men most likely to become leaders. These got further training, some in cadre schools. Others at officer candidate schools—all in actual practice in the field. Seventy-eight per cent of our wartime officers were former enlisted men.

That it worked is evidenced by the fact that our troops fought well and displayed real qualities of leadership. But because it worked in war does not mean that we plan to freeze it.

Our training methods are constantly changing. We use the best we can get from our own research and from educators all over the country.

LEADERSHIP BY EXAMPLE

During the war we had to stress practical training. But we tried to instill leadership as well as discipline.

Some of your own people helped us set practical examples of leadership for our men.

Early in the war, a tank had been developed which was a compromise. It was tested in the field and the enlisted men who handled it complained that the filters were too small.

The factory engineers replied that the filters should be O.K. but that they would send out a representative.

He went with the enlisted men over the tank course. When he returned, he recommended to the factory that the filters could not be made too large for the tanks.

That was an example of dynamic active leadership because it did several things.

The engineer representative was willing to be shown that certain factors had cropped up unexpectedly.

Immediately he was shown, he reacted intelligently.

The whole episode, even though a minor one, brought about an improved tank, increased co-operation, and set an example of leadership to the men that beyond a doubt influenced their own actions later on.

This representative was teaching leadership by example, an excellent way, particularly when seeds of leadership are present.

It brings up the question: Who shall we train and how shall we determine this?

Our present practice, and I think it is a good one, is to give everyone the opportunity and encouragement and to let the laggards fall by the wayside as we go along. I note by figures made available, that 40 per cent of all men who take engineering in college flunk out—fail to graduate.

That does not indicate that the 60 per cent who do graduate are by any means engineers or leaders. It merely shows that the selection of who is to take engineering work has been successful in that percentage.

The Army has had a somewhat similar problem of selection.

It uses tests, records of past work, close scrutiny during actual training as in officer-candidate schools, and personal interviews by trained boards.

Much of our success in battle has been due to this method. Our failures can be blamed on weakness in it.

Generally speaking, we certainly cannot blame our failures on either lack of equipment or ineffectiveness of it.

For this the engineers rightly deserve the credit. The best brains, skill, industry, and leadership of the engineering profession were constantly at the service of the government throughout the war.

As I understand it, the broad subject of this Society during the war was arms and armament. The results prove you did nobly. As commanding general of your best customer, the Army Ground Forces, I want to thank you for your efforts.

I was using most of your products when the going got pretty hot. The arms and armament you engineered helped us defeat the best that Italy, Germany, and Japan could offer. That is a mighty testimonial.

If any further testimonial is needed, I can refer you to the German commander who, unfortunatey for him, ran into the American type leader (as opposed to the *Heil-der-Fuehrer* type), and found himself a prisoner. This German commander had been so impressed by the rapid fire of our 105-mm guns that he asked to see our "automatic" artillery.

Or for testimony about our tanks I can give it to you. We captured or destroyed all the German tanks. At any rate, the Germans didn't seem to care too much about being on the receiving end of either our guns or our tanks.

Your direct contribution to the war is measured not only in actual arms and armament, but in terms of personnel. I refer not alone to those who died, but also to the thousands of young men whose careers as engineers have been delayed or shortened by four years of service in the Armed Forces. We cannot give back those years, any more than we can give back the lives we tendered for victory.

THE PROBLEMS WE FACE

By L. A. HAWKINS

FORMERLY EXECUTIVE DIRECTOR, RESEARCH LABORATORY, GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

I FEEL truly honored by the invitation to speak at this meeting of The American Society of Mechanical Engineers, and I also feel it both a privilege and a duty to contribute what I can on the subject of this afternoon's discussion. I sincerely believe that no engineering society has ever before attacked so important a subject, one fraught with so many consequences for good or ill, as is the theme to which you are about to give your earnest consideration.

It is a subject which has a vital bearing on all aspects of our national life, for it has vast potentialities in the fields of public health, economic welfare, and national security. It is a subject of great complexity also, for it is inherently enmeshed with our foreign policy and our international relations. If our foreign policy is such as to generate fear or distrust, so as to promote an armament race toward the goal of another and unprecedentedly horrible war, then we can find little consolation or lasting benefit in amelioration of our domestic conditions. And, conversely, since only the strong can command attention today in international councils, a failure to foster our strength at home will weaken by so much the influence we can exert in behalf of lasting peace and world security.

In approaching my subject, I have been gratified and greatly relieved by the assurance that I might utter my opinions freely, whatever they might be. It would have been hard for me to have refrained from their frank expression, for my belief in the enormous value of scientific research is so strong, and my desire to see it fully utilized for the national welfare is so keen, that I would find it almost impossible to maintain neutrality on controversial points. I realize that some of my thoughts may not find acceptance with all of you. They are merely the thoughts of one individual. My only excuse for trespassing with them on your time is that they are the product of a lifetime spent in close association with research and its applications, and of the enthusiasm for research which that experience has generated.

COMBINED POWER OF SCIENCE AND RESOURCES

The events of the greatest of all wars, now happily ended, have demonstrated in a spectacular and most convincing way the tremendous power of organized science backed by adequate resources. Not only our leaders in all fields—political, military, industrial, and educational—but also the general public are fully awake to the magnitude of this power and are sincerely and strongly desirous that it be brought to bear on the constructive activities of peace as effectively as it contributed to the destructive processes of war. The earnest intention prevails to develop and apply our nation's scientific resources with the fullest effectiveness for the common good. The danger is that that intention may be frustrated by faulty planning, as the result of inadequate understanding of essential factors, of emotional thinking or of bias by misleading preconceptions. It is to those two points—the sincerity of the intention and the misconceptions which may frustrate it—that I wish, with your permission, to direct my remarks.

The education of the American public in the value of scientific research began with World War I and was completed in World War II. In 1914, when the British fleet took its stranglehold on German commerce, the rest of the world was shocked to find how dependent its industries had become on the products of German laboratories. Dyes, optical glass, many chemicals and essential drugs, many special alloys and some metals like magnesium had been produced only in Germany. In consequence, at the beginning of the war only the German army had magnesium for flares and an adequate supply of anesthetics for its field hospitals.

There was relatively little research in American universities then and there were few industrial research laboratories, but those few gave valuable help in breaking the bottlenecks resulting from lack of German products, and, after the United States entered the war, in developing new equipment for the Armed Forces. The laboratory with which I am connected made important contributions in submarine detectors, wireless telephony, and portable X-ray equipment for the field hospitals.

RESEARCH LABORATORIES ESTABLISHED AFTER WORLD WAR I

As a result of its help in war production and improvement of armament, research began to be more generally appreciated. During and after the war, industrial research laboratories multiplied rapidly, university research greatly increased, and the Naval Research Laboratory and other governmental laboratories were organized.

Consequently, World War II found us much better equipped in trained personnel and research facilities, and those resources were more thoroughly and efficiently mobilized, thanks to the extremely able leadership of the National Defense Research Committee and the Office of Scientific Research and Development. The scientific results achieved in this most mechanized of all wars were correspondingly great.

The full story of scientific achievements in this war has not yet been told, but enough has been published to give the public some conception of their variety and magnitude. Blood plasma, penicillin, and DDT are already bringing their benefits to civilians. A countless number of new materials and new devices contributed to the quality of our armament or to the speed of its production. Most spectacular of all war developments were radar and the atomic bomb, the first of which averted defeat in the early days of the war, and the second helping to hasten its end.

It is to be hoped that the world will never forget its debt to the gallant heroes of the R.A.F., those few to whom so many owe so much. Without their courage and skill the Battle of Britain would have been lost, the whole course of the war would have been altered, and our state today might have been such as we shudder to think of. But I hope that the aid given by British scientists and technicians will also be remembered. They were far from asleep. When Chamberlain flew to Munich on his futile mission of appeasement, British radar followed the course of his plane. Later in the aerial blitzkrieg it was British radar which gave the gallant fighters of the R.A.F. sufficient warning of the approach of the enemy to enable them to get into the air at the right place and in

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time to meet the invading planes. Later, radar, improved by American science and engineering, became omnipresent in war, making possible such miracles as the accurate bombing of strategic targets through overcast and the surprise-sinking of enemy ships at night.

Then came those devastating blasts at Hiroshima and Nagasaki, astounding the world with the fact that science had at last smashed the doors to the vast storehouse of energy locked up in the heretofore impregnable nucleus of the atom and had produced a new weapon of horrible destructiveness, more than a million times more potent, pound for pound, than TNT. Research had proved its power by the most spectacular achievement in the history of science.

So today the American public fully indorses the request made a year ago by President Roosevelt in his often-quoted letter to Dr. Vannevar Bush that a way be found to carry over into peacetime for the national good the same kind of organized scientific research which had proved so powerful in war.

In response to the President's request, Dr. Bush submitted a report, which in my opinion adds another item to the huge debt of gratitude our nation already owed to him for his exceedingly able administration of the research on military projects throughout the war. That report, entitled "Science, the Endless Frontier," sets forth a recommended program for postwar research which is comprehensive, logical, and firmly based on his unrivaled experience as administrator of the greatest research undertaking the world has ever known.

CONGRESS CONSIDERS POSTWAR RESEARCH FOUNDATION

The recommendations by Dr. Bush have been embodied, I believe adequately, in a bill introduced into the Senate by Senator Magnuson and, along with four other bills, now under consideration by the Military and Commerce Committee of the Senate. I shall not take time to discuss three of them, for they are of more limited scope, and their objectives are substantially included in the other two.

The two more comprehensive bills are that of Senator Magnuson, already mentioned, and one introduced by Senator Kilgore. The two bills profess the same objectives, and have many similarities, but I believe that the Magnuson bill is much to be preferred.

That bill provides for a Research Foundation headed by a board of nine members appointed by the President solely on the basis of demonstrated capacity. The board is empowered to elect a director and to organize divisions to promote research in the fields of medicine, basic science, and military security, two members of the divisional committee for the latter field being appointed by the Secretaries of War and of the Navy. Thus the control is placed in the hands of scientists of proved ability, and the very necessary liaison with governmental departments is established at the divisional level. This is substantially the plan that worked so well in the huge war research program.

The Kilgore bill, in contrast, sets up a Board composed, half and half, of government officials and representatives of the public, with a Director appointed by the President. The President also appoints the chairmen of the research divisions. This obviously offers more room for politics to creep in and is likely to result in a disturbing change of responsible personnel with every change in the White House.

As regards research in the medical and basic science fields, both bills properly contemplate that the work be done in universities and nonprofit research institutions. The only difference is that the Kilgore bill fixes the percentage of the total expenditure to be allocated to each field, while the Magnuson bill does not. Anyone who has had experience with research budgets and the varying fortunes of research projects knows how advantageous it is to have wide latitude in revising from time to time the allocation of funds.

It is when we come to research in the military field, surely a matter of deep national concern pending the demonstration of the effectiveness of U.N.O. in maintaining peace, that we find a most serious difference between the bills, a difference, in my opinion, between workability and inoperativeness. Military research is essentially applied research, the type of research found in all industrial research laboratories. It is work for which they are uniquely fitted by their close contact with engineering and production processes. It would be exceedingly costly to duplicate in governmental laboratories the facilities and specialized know-how already available in the more than 2000 industrial research laboratories of the nation. Both bills therefore contemplate the utilization of the know-how and facilities of these laboratories for a substantial part of the military research and development. But the Kilgore bill contains a provision which would make such utilization ordinarily impossible. It provides that all rights to any invention made in the course of a research project, financed in whole or in part by the government, shall belong exclusively to the government.

LIMITATIONS OF KILGORE BILL RELATING TO MILITARY RESEARCH

Now let us see how that would work out in practice. Let us assume that the Army has in mind a new type of robot bomb, the success of which depends on the development of an alloy more resistant to high temperature than any yet available. And let us suppose that the Research Foundation turns to a manufacturer with a strong metallurgical laboratory, which over many years and with large research expenditures has developed a number of successful high-temperature alloys which are covered by patents. Now no industrial company is anxious to divert any part of its research facilities to the projects of others. It is much more profitable to keep those facilities engaged on its own problems. But suppose from motives of patriotism the company accepts a contract and is highly successful, producing a better high-temperature alloy than any before. Now that company finds that it has no rights to that alloy. The government may license its competitors to make and use it, so its former patent position, obtained by years of work and expenditure of hundreds of thousands of dollars, has gone with the wind. Can government expect any company's patriotism to extend so far as to be willing to accept such a risk? Is it fair or reasonable to ask it?

INDUSTRY SHOULD RETAIN COMMERCIAL RIGHTS TO DEVELOPMENTS

Dr. Bush in his report truly says that ordinarily it should not be necessary for the government to insist on exclusive patent rights. Ordinarily, a royalty-free license for all governmental use should be adequate, so that commercial rights may be retained by the company. He therefore recommends that it be left to the judgment of the Director of the Foundation to decide whether special circumstances warrant the government's demanding in certain cases more exclusive patent control than is given by a royalty-free license. Accordingly the Magnuson bill leaves open the question of patent rights.

I can conceive of any company's accepting, not eagerly but from patriotic motives, a research and development contract under the Magnuson bill, with a patent clause the same as was standardized by O.S.R.D. for war research contracts. I cannot imagine any company accepting such a contract under the Kilgore bill. The patent provision in that bill in my opinion renders nugatory the entire portion which relates to the extremely important field of military research.

There is one exception to be noted. It evidently was the special case which Dr. Bush had in mind when he drafted his report, but which necessary secrecy at that time prevented him from identifying. It is the same exception which was made in the O.S.R.D. war contracts. In the project camouflaged by the name "Manhattan," the government demanded, and the participating industrial companies agreed, that all patent rights to all inventions relating to the process or to apparatus specially designed for the process should be assigned outright to the government.

This project was of course the one dealing with nuclear fission and the development of the atomic bomb. Industry recognized the special circumstances which made the government's requirement both necessary and reasonable. The potentialities of the project were so vast and so uncertain in their nature that national security required full governmental control; permitting even partial monopoly by any industrial company was unthinkable; the field was so new that no participating company was jeopardizing substantial assets built up by past research and expenditure; and success might bring such benefits to the entire nation as to constitute a fully adequate reward to all who had co-operated to achieve it.

NUCLEAR FISSION, A NEW FRONTIER

This brings me to the final and most important item in my discussion, nuclear fission. It is by far the most important in every aspect—scientific, economic, social, military, and international. Now that the atomic bomb has revealed the momentous fact that research has opened the way to the utilization of the enormous concentration of energy within the atomic nucleus, physical science stands today where Europe stood when Columbus announced the discovery of a great new world, of unknown dimensions and unknown riches, calling for vigorous exploration and development. Europe then could not foresee what the Western Hemisphere would yield, and in truth most of the expectations first entertained proved wholly illusory. The Americas yielded no Eldorado, no Fountain of Youth, no Northwest Passage to the Orient, but, after centuries of daring pioneering, initiative, and perseverance, it produced the greatest agricultural and industrial civilization, the highest standards of living, and the noblest political institutions that the world has yet seen. So our speculations today on the ultimate uses of nuclear energy may prove illusory, but who can doubt that those uses will be of enormous importance? When J. J. Thomson, less than half a century ago, identified the electron, who could have foreseen that electronics would bring us radio broadcasting, television, the talking movie, and the multifarious industrial applications of vacuum tubes? Electronic developments are still multiplying and increasing in utility, yet all this has come from a mere skimming of the surface of the atom, utilizing nothing more than transformations of energy. Who can doubt that now, when we have pierced to the atom's heart and have made available the creation from matter of energy in a new and tremendously concentrated form, we shall ultimately develop uses of far more fundamental importance and widespread utility than all that electronics can yield?

But such riches can be developed only by long, arduous, courageous, co-operative pioneering by the world's ablest scientific minds. America must do her part, not only as an obligation due to all mankind but also in order that we may share early and in full measure in the benefits to come. Research in the basic sciences, such as is contemplated by both the Magnuson and Kilgore bills, should be limited in its extent only by the available supply of scientific brains competent to undertake such exacting research.

I wish to give only brief consideration to the May-Johnson bill dealing specifically with nuclear research and development. Had that bill retained its original form in which it was rushed through the House of Representatives, I would have much to say. In its original form it was a monstrosity, setting up a commission with unprecedented arbitrary powers, superior alike to the law of contracts and Congressional control, placing American nuclear research in a strait-jacket, while leaving foreign scientists free, and providing savage penalties savoring of the Gestapo for violation of the least of its regulations. Fortunately, the Senate has been more deliberate, permitting the protests of scientists to be heard, and now the bill has been shorn of its worst features and toned down to more reasonable form. Its original is now of interest only to indicate how far astray we may be led by emotional thinking and snap judgment based on inadequate understanding.

I shall not venture to speak of the military aspects of nuclear energy. Your program includes speakers possessing military authority to which I can lay no claim, but, because of its tremendous importance, overriding, in my opinion, all other considerations, I do wish to close my remarks with a few words on the international implications of the atomic bomb.

There has been much public debate as to how much of a secret we possess and how long it will remain a secret. Among scientists, at least, there is general agreement that all the fundamental principles on which the atomic bomb is based are known to all the world, and that it is only the engineering know-how, of process and equipment and of details of bomb design, which we now monopolize. The time required by another powerful industrial nation to develop such know-how, without help from us, has been variously estimated at from three to ten years. Since we, in three years, successfully developed, as shown by the Smythe report, four different processes for producing the essential materials, and incorporated two of them in terribly effective bombs, it seems to me that even three years would have been a generous estimate of the life of our "secret."

OUTLAW USE OF ATOMIC BOMB

But that was relatively unimportant. The vital question was what use we should make of our temporary monopoly of know-how. For a time it seemed to me that we were fumbling a great opportunity. I can see no hope of averting the coming of the most horrible of all wars except by the establishment of a strong international organization to outlaw atomic bombs and enforce their outlawry. Therefore any act which promotes such establishment I think beneficent. Any act which threatens or delays it I think vicious. It seems to me, that, with the revelation of the existence of the atomic bomb, two courses were open to us. One was to say to the world, "All our know-how will be fully yours as soon as you and we have created an organization with the strength and will to control it for the good of all." That would have given a new and powerful incentive to all nations to speed up and to strengthen the organization of the United Nations. Or we could say to the world, "We have this secret; we intend to keep this secret; we shall pass rigid laws to enforce perpetuation of this secret; we are self-appointed trustees of this power and you must trust us to give you a beneficent Pax Americana." This at first seemed to be the alternative we had adopted. All early official utterances and official actions, such as the passage by the House of the original May-Johnson bill with all its stringent penalties for revealing information, and with no intimation that the regulations would ever be relaxed, have emphasized an intent to maintain secrecy as completely and as

(Continued on page 16)

MANAGEMENT'S PEACETIME RESPONSIBILITIES *and* OPPORTUNITIES

By REGINALD E. GILLMOR

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IT is is inevitable nowadays that almost all speakers refer to that smallest of organizations which the Chinese call the original thing and we call the atom. I am no exception.

My atom story relates to a conversation which some of my colleagues and I had a few days ago with two scientists. The two scientists had been associated with each other before the war but had not seen each other for some time until they met at our lunch table. Both were well acquainted with nuclear physics. Both were very able mathematicians in addition to their other attainments. The subject of the atom bomb came up, as it always does.

One of the scientists, whom I will call Dr. A., described some calculations he had made as to the possible effects of underwater explosions of atomic energy. The conclusion he had reached was that, given a not very large amount of atomic energy immersed in a not very great depth of water, it would be quite possible to create conditions of temperature and pressure not heretofore experienced in the life of this planet and that these conditions might start a chain reaction in the oxygen atoms of the water *which could not be stopped*.

The other scientist, Dr. B., after listening attentively, commented that the conclusion reached by Dr. A. had a bearing on some calculations that he and some of his astronomer colleagues had made in an endeavor to explain the super-novae. The super-novae, I gathered, are stars that suddenly flare to a high brilliancy and disappear in a few days.

Dr. B. reminded us that since the development of 100-inch telescopes and the perfection of astronomic photography, scientists have come to realize that our own galactic system, of which the Milky Way is a part, is but one of thousands of similar systems within the visible universe. Each of these systems contains myriads of stars. If you have seen some of the telescopic photographs of our own Milky Way at the Hayden Planetarium, you will know what is meant by myriads of stars.

Most of these stars are no doubt the center of planetary systems of worlds similar to our own. Dr. B. and his astronomer colleagues had estimated the number of such worlds in the visible universe. To this estimate they had applied the theory of probabilities to determine successively:

(1) The number of inhabitable worlds.

(2) The number which had been inhabited long enough to have evolved a being which would understand atomic energy.

(3) The number which would each year destroy their world by misusing atomic energy either accidentally or in wars with each other.

The figure they finally arrived at coincided almost exactly with the number of super-novae that are seen each year. The last super-novae in our own galactic system occurred in 1120. The periodicity in our system should be, as I remember, about 800 years. A super-novae in *our system* is now overdue.

This story may help to give us perspective and to emphasize the interdependence of mankind. The reason I tell it, however, is to draw attention to the great discrepancy between man's progress in the exact sciences and his progress in the very approximate *art* of human relations. This discrepancy is symbolized at present by the atomic bomb on the one hand and, on the other, the sorry state of human relationships—international, national, and industrial—which is disclosed to us every day by the press and radio.

We cannot stop the progress of the exact sciences or the mechanical arts, but we can and must advance the progress of human relationships, particularly in the fields of ethics, economics, politics, and administration.

ART OF ADMINISTRATION IS MANAGEMENT'S RESPONSIBILITY

Management's greatest responsibility and opportunity is the advancement of the art of administration. It is a great *responsibility* because the governing of men underlies and controls the progress of all other phases of human relations. It is a great *opportunity* because the development of new concepts in any field of management—industrial, for example—will be of value in all other fields, governmental and social.

To begin with there is a great need for precise management terminology. No science or art can progress very rapidly until the terms employed in it are carefully defined. The physical scientist knows exactly what he means when he uses the terms erg, ohm, and a vast lexicon of other precisely defined scientific terms.

Management's terms are for the most part vague and ambiguous. Consider, for example, the absence of precision in the words government, administration, control, co-ordination, management. All of them have a variety of meanings and some of these meanings are common to all of them; in fact, management can be interpreted to mean any or all of them. Incidentally, the word "manage" came from *manège* the training of horses. We're still not entirely free from the tendency to handle people like horses.

The physical sciences not only utilize precise terms but have for their guidance well-established principles, such as, for example, Newton's laws of motion. In the art of organization and administration there are no *generally accepted* principles. To be sure many excellent books have been written on the

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philosophy, the principles, and the practice of administration and there is some general agreement among management engineers as to such principles as definiteness of function, correspondence of responsibility and authority, limitations to the span of control, maximum delegation and autonomy, and the separation of planning from executive functions. For the most part, however, the principles are looked upon as academic and are more honored in the breech than the observance.

Many industrial organizations do not even subscribe to the principle of defining the responsibility and the corresponding authority of the various positions in the organization. At a recent meeting of the American Management Association, Marvin Bower made the statement that it was unusual to find an organization in which the functions of the various positions are carefully defined. Mr. Alvin Dodd commented, in the manner of true words spoken in jest, that he now had applications from 502 vice-presidents for the formation of a vice-presidents' union, the principal objective of which was to secure a definite statement of their functions. No man can make full and effective use of his talent and energy unless he knows for what he is responsible, to whom he is responsible, and how he is to be judged.

Absence of adherence to principle also leads to continual change in organization structure. In far too many cases the structure is designed for the individuals who are available. The proper way, of course, is to design the organization structure in accordance with sound principles and choose the individuals to fit the structure.

QUALIFICATIONS FOR ADMINISTRATION LACKING

Another indication of the backwardness of the art of administration is the fact that no qualifications in education and training are required to practice the art. A doctor of medicine cannot practice until he has met definite standards of requirements prescribed by the state in which he is to practice. Almost everyone thinks he would be a good executive and there is no way to determine whether he is or not, except by the expensive process of trial and error. Such training as is given to executives is usually applied at the lower levels—the result often being to make the lower levels critical of their seniors when they find that the senior does not practice the precepts which have been taught to the junior.

One of the most difficult problems in human relations arises from the indefiniteness of management's social responsibility. Its only direct responsibility at present is toward its stockholders; it cannot assume responsibility for building up purchasing power as well as purchasing desire, but unless it is given that responsibility, all stockholders will suffer from decreasing markets and profit margins as well as high taxes and social instability resulting from widespread unemployment.

A similar situation exists in union management; its principal responsibility is to get the highest possible wages for its constituents, but carrying this to an extreme results in increased costs, higher prices, and the dangers of inflation, social instability, and unemployment. No doubt the leaders in both management and labor fully appreciate this problem, but they do not have the authority to solve it.

The slow progress in the art of administration cannot be laid to the administrators any more than the absence of agreement on the structure of the atom one hundred years ago could have been laid to the physicists of that time. The phenomenon and its underlying laws and principles simply had not been developed and proved.

The reason for the slow progress in the art of administration is not hard to find. It is due to the inability to separate variables and to prove principles by measurement. The exact sciences progress with great rapidity because they can separate variables, measure each variable precisely, and, by the technique of the reproducible experiment, prove all of their tenets. No corresponding means exists in the art of administration. The nearest we have ever come to having such a means was World War II.

MANY WARTIME ADMINISTRATIVE SCHEMES SUCCESSFUL

A great number of administrative schemes were tried out in the federal government, in the Armed Forces, and in industry in all combatant countries. Some were obvious failures, some were spectacular successes. As this vast experience is disclosed and analyzed we should be able to add greatly to our understanding of administrative principles.

The absence of means for proving should not discourage us however. Mankind has made enormous progress in other aspects of human relations, the value of which could not be proved. Edgar Queeny says in his interesting book "The Spirit of Enterprise:"

"Step by step our conception of human relationships has improved. Long ago we abandoned human sacrifice; later we ended slavery, indenture of workmen, duels, and ruthless imprisonment. Step by step our solicitude for our fellow human beings has grown. Fiendish entertainment afforded by the suffering of gladiators belongs to antiquity, along with the diabolical fury exhibited by the Puritans when Stafford was permitted to die without seeing his own bowels burned before him. We are moved to war not for glory or conquest but as a means to peace. Women are no longer chattels and consigned to the meanest drudgeries of existence. Indeed, in America all human beings have at least equal civil rights.

"In spite of sporadic outbreaks of atavism such as the Nazi's aggravated exhibit, since the acceptance of Christianity by the western world the long-term trend has been toward application of the Golden Rule and the Ten Commandments."

Moreover, every science and art, including all of the exact sciences, have had their beginning in faith and imagination without proof. Galileo, for example, had faith in the Copernican theory of the solar system before he could prove it and he stuck by his faith even through the torture and imprisonment of the Inquisition. The laws on which the Copernican theory was based were eventually proved. There is little doubt that principles of administration now unknown or mere theory will eventually be developed, applied, proved, and accepted.

In the present day administration is an art and it is assumed that it will never become a science based on fundamental laws. This assumption cannot be correct. Fundamental simply means in accordance with the laws of nature. It is obvious from all we see of natural phenomena that its organization and administration are based on laws which are *fundamental* in character.

Every sentient *organism* is a complex *organization* involving an extremely intricate administration of its numerous functions—a problem far more complex than that involved in any man-made organization. Even the prehistoric organisms had remarkably efficient administrative systems.

Consider the dinosaur, for example. He was the dominant animal on this earth for 140 million years—much longer than any other animal before or since. Dr. Edwin Colbert, of the American Museum of Natural History, in his interesting book on the dinosaur, describes what might be called its administrative organization. This organization comprised three autonomous centers—one in the head which served primarily as a receptor for sight, sound, and smell, a second in the spinal column above the shoulders for controlling the forward part of the body, and a third near the rear end of the spinal column

for controlling the hind legs and tail. An amusing description of this organization has been written in verse by Bert Leston Taylor:

Behold the mighty dinosaur,
Famous in *prehistoric* lore,
Not *only* for his power and strength
But for his *intellectual* length.
You will observe by these remains
The creature had *two sets* of brains—
One in his head (the usual place),
The *other* at his spinal base.
Thus he could reason "A priori"
As well as "A posteriori."
No problem bothered *him* a bit
He made both *head* and *tail* of it.
So *wise* was he, so *wise* and solemn,
Each thought filled *just* a spinal column.
If *one* brain found the pressure *strong*
It passed a few *ideas* along.
If something slipped his *forward* mind
'Twas *rescued* by the one behind.
And if in error he was caught
He had a *saving afterthought*.
As he thought *twice* before he spoke
He had *no judgment* to revoke.
Thus he could think without congestion
Upon both sides of *every* question.
Oh, *gaze* upon this *model beast*,
Defunct *ten million* years at least.

Man's body involves a much more complex administrative problem than the dinosaur's. The management of the great majority of our functions is completely decentralized to autonomous manufacturing units such as the glands and autonomous service systems such as the circulatory, the respiratory, and the digestive systems. That part of the administration of the body which is responsible for the co-ordination of the entire organization is called the central nervous system; it comprises what might be called *four* administrative centers, (1) the spinal cord which takes care of the automatic reflexes, such as dodging a missile; (2) the brain stem which governs the semiautomatic processes, such as breathing; (3) the paleoencephalon which manages the more complex co-ordinations, such as talking, walking, and writing; (4) the neo-encephalon which is the center of thought, memory and will. The neo-encephalon, as the psychiatrists call it, is free to think and plan undisturbed by the other complex administrative problems of the organism. Thinking and planning involve consultation with memory, conscience, and other departments of the neo-encephalon.

If you would like to know more about the wonderfully complex and efficient administration of the human body, you need only consult the Encyclopedia Britannica. Here is a sample—the first paragraph of a six-page article on blood.

"The general principle on which the chemical life of the body is conducted is that each living cell carries out in its own substance all those chemical processes necessary to its existence. Therefore, all the materials must be carried to it and all those which it discards must be removed. Throughout the whole body therefore a system of transport is necessary, with which every living cell is in intimate contact. That system, very primitive in the case of more humble creatures, has become highly specialized in the vertebrate creation."

Here, in this one paragraph from the Encyclopedia, we have descriptions of: (1) Delegation and autonomy carried to the ultimate; (2) co-operative interdependence; (3) specification of the most intricate character (there are nine different kinds of white blood corpuscles, each serving a definite function).

Even a superficial knowledge of the administrative systems and principles employed in natural organisms is sufficient to give us faith that they are fundamental in character and that their application to man-made organizations would benefit us all *and* in many ways.

We in management are pioneering in one of the most important and difficult phases of the relatively young art of human relations. While taking satisfaction in the progress we have made we must not forget that the art of human relations with its essential component, management, is now the limiting factor in the progress of mankind.

We must make further and faster progress by applying the scientific and engineering technique of disregarding the conventional, discovering and accurately expressing the fundamental laws, and co-operating with each other to gain the general acceptance and application of those laws.

The Problems We Face

(*Continued from page 13*)

long as possible. The distrust of our Allies and lack of confidence in the future of U.N.O. which we thus showed could evoke only distrust and fear in other nations and poison the international atmosphere. The initial use we thus made of nuclear energy was all for evil, but we may hope that it is not too late to repair the damage.

It was glorious news that emerged from the Truman-Attlee-King conference, that we have turned away from the isolationist policy of rigid secrecy, which would surely have led to the most direful armament race in history, and have agreed to use our temporary advantage to promote the consolidation of a strong international organization, through which alone can we hope to find effective outlawry of the atomic bomb and peaceful security for the world.

In the anxious months between the blast at Hiroshima and the recent historic conference of the leaders of the Anglo-American powers, I have often thought of that classic story by Frank R. Stockton, "The Lady or the Tiger?" You remember the hero was forced to choose between two doors, behind one of which was a beautiful and charming girl, promising a lifetime of happiness, while behind the other was a hungry man-eating tiger, ready to bring immediate and cruel death. The atomic bomb seemed to me a key to open such alternative doors, to security and well-being, or to ruinous disaster. I rejoice with all my heart that after alarming hesitation, we at last seem to be placing the key in the right door.

I do not mean that unlocking that door will bring us immediately to lasting peace and security. I mean only that we shall have started on the right path. The problems that will still confront us are indeed many and difficult and fraught with momentous consequences, but they must be solved. We must not lapse into defeatism, for the ultimate consequence of such weakness would be overwhelming disaster. But if we resolutely turn our backs on defeatism and face our problems with courage and with open minds, we can glimpse beyond them an inspiring vista of a great new world. Out of the past war, out of its blood and sweat and tears, its enormous sufferings and sacrifices, have come two great benefactions—unprecedented scientific achievement and a new spirit of unity among nations. If we can carry these over into peace and can foster the development of their full potentialities, we shall be able to bequeath to our children's children a heritage of peace, security, and well-being such as this world has never known.

ORDNANCE SUPPLY SYSTEM

II—Scheduling Depot Operations

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THE general problem faced by the Ordnance Department in the performance of storage activities at its 53 United States depots was discussed in the first section of this paper, of which this is the second of four sections. It is the purpose of the present section to describe adaptations of accepted management practices now standardized by Ordnance for daily scheduling of its storage work load.

ORDNANCE'S DEFINITION OF SCHEDULING

When an Ordnance depot operator refers to scheduling, he means the daily development of a formalized plan for the performance of work at the right time, at the right place, in the proper sequence, and using that method which will result in the least expenditure of manpower per unit of production. His approach to the carrying out of the scheduling operation is strictly conventional, i.e., he first determines what work must be done and when it should be completed; then he decides where the operation should be carried on, and by what person or persons, method, and equipment.

Depot operators have not always used the standardized scheduling procedure described in this paper. Early in the war, when depots were first placed in operation and staffed by personnel brought from all types of industries and positions, the work to be done was so new that necessary elements for daily scheduling were not immediately available. Particularly, information was lacking as to the best method for the performance of any particular job. It was not an unusual condition to find in one day, at one installation, the unloading of 75-mm projectiles from railroad cars into igloos being performed by five different crews using as many various methods. Moreover, the newness of the organization, with lack of time available to develop interdepartmental co-operation, resulted in lack of information as to just what work should be done each day.

Ordnance uncovered no new principles in building a program to overcome these difficulties. However, the method used to develop, in 3 years, a closely scheduled operation in half a hundred field installations may be of interest to industries which were faced with a similar problem during the same period and others having a like task facing them in the forthcoming re-establishment of networks of foreign installations.

THE JOBS TO BE DONE

Ordnance divides its scheduling into four phases: A listing must be made of the work to be performed. This includes not only that which must be done during the immediate period for which work assignments are being made (usually 24 hr) but all other outstanding work projects as well. Such a listing insures that no job is inadvertently overlooked and that the person doing the scheduling takes maximum advantage of saving through job combinations.

The work to be performed in the storage activities at an Ordnance depot falls into three categories: The depot commander must see that shipments are made to the using forces in conformity with requisitions placed upon him. This may mean the removal from storage and placing 1, 10, or 50 identical carloads of such an item as 250-lb bombs in boxcars, or it may involve the selection of small quantities of spark plugs, piston rings, and bearings from bin stock and packing them for delivery by parcel post. By far the greatest tonnage is removed by carload lots.

The commanding officer must also make adequate provisions to unload, sort, if necessary, and place in stock new material being received from manufacturers or items being returned from the using troops.

The third category of work is referred to as "backlog" or "rainy-day projects." It includes those miscellaneous activities essential to the operation of a storage depot, but usually having no date on which they must be completed. An example of this type of work is the rewarehousing and consolidation of small tag-end lots of items in order to consolidate scattered vacant space. It is also possible that some material in storage has been declared obsolete and there is a job of removal from storage, disassembly, and disposal through salvage channels. In the case of a depot handling ammunition, it may be that using troops call for items in a different type of package from that in which the material is then stored. Accordingly, when receiving and shipping activity is light, personnel must be set to the task of repackaging.

Of the three categories of work, it has been found that most care need be taken in the case of backlog projects to insure that adequate information is available for scheduling purposes. There was frequently a tendency on the part of operating personnel not to formalize such work, but merely to carry in their heads that "such-and-such a job" must be done "at some time in the future." To overcome this difficulty, a "backlog work-projects inventory," Fig. 8, was developed. Field supervisors are directed to forward to the office of the storage officer, where this record is maintained, information concerning proposed backlog work. This will be particularly concerned with rewarehousing materiel in storage and reworking items requiring preservative action. The storage officer, on instructions received from his superiors, adds such projects as salvaging and repackaging. Each proposed project is listed on the register with information sufficient to describe the work to be performed and labor requirements necessary to complete the job. At a weekly supervisors' meeting, the storage officer discusses each outstanding project on the register and assigns a priority in order of urgency of performance. As projects are completed,

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This series of papers was planned and prepared under the direction of Colonel L. J. Meyns, Chief of the Storage Division, Field Service, Office, Chief of Ordnance, by Major Preston D. Carter, Assistant to the Chief of Storage Division, Field Service, Office, Chief of Ordnance. Major Carter was aided in the Section on Packaging by Mr. A. L. Whiton, Chief of the Packaging Branch, Industrial Service; in the Section on Scheduling Depot Operations by Major Ira A. Ruhl, Control Officer, Pueblo Ordnance Depot. The Section on Ordnance Storage Techniques was prepared by Major Warner H. Davis, Control Officer, Letterkenny Ordnance Depot, and Major R. S. Craig, Administrative Officer, General Supply Division, Letterkenny Ordnance Depot.

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BACKLOG WORK PROJECTS INVENTORY DATE _____

ACTIVITY	ITEM OR DESCRIPTION	QUANTITY ON HAND COMPLETED	QUANTITY TO BE DONE	MAN DAYS REQUIRED	PRIORITY	REMARKS
Package for overseas	Rocket Launchers	12,042	72,864	2,478	3-1	
Bootstering Bombs	1000 # Bombs	8,270	32,470	6,720	3-1	
Rewarehousing	Gen. Supplies		180,000	1,200	3-2	To make available potential space
Salvage	Metal and Lumber			15,000	3-3	To be done as workload permits
			TOTAL	25,398		

FIG. 8 RECORD USED BY DEPOT STORAGE PERSONNEL TO ASSEMBLE DATA REQUIRED FOR SCHEDULING NO. 3 PRIORITY WORK

or partially completed, appropriate adjustments to the inventory record are made.

In order to insure that individual depots do not accumulate too large backlogs, or schedule performance of work not essential to efficient depot operations, copies of the inventory are forwarded to Washington for monthly review.

ASSIGNMENT OF PERSONNEL AND EQUIPMENT

The second phase of scheduling a depot's operations concerns itself with the assignment of personnel and equipment to the performance of work in order of priority. In doing this, the labor force at an installation is thought of in terms of a reservoir of potential energy; and in assignment of work, this reservoir is drawn upon first in sufficient volume to fill the needs for accomplishment of No. 1 priority jobs. When sufficient labor and equipment have been earmarked for the performance of this work, additional quantities are scheduled for No. 2 priority work. Sometimes there is not sufficient labor available to fill all No. 2 priority requirements. When this is the case, some projects must be carried over to the next day's schedule. On days when all of No. 2 requirements are filled, labor and equipment are directed to the performance of No. 3 priority work.

Because the function, for the performance of which depots were designed, is to supply troops in the field, the filling of shipping requisitions is assigned No. 1 priority. The unloading of incoming material and replenishment of stocks receive No. 2 priority classification, and the balance, or backlog projects, are classified as No. 3 priority. Within any one of these categories, of course, a further breakdown of classifications is sometimes made. For backlog projects, this has already been discussed. In the case of shipments, the filling of an emergency requisition, resulting from battle shortage, would receive all possible expediting. An example of this occurred during the Battle of Tunisia when, in the midst of the fight, it was found that a particular fuse was required in quantities exceeding those listed in original requirements. A radio requisition from General Eisenhower to Washington resulted in the air-shipment of required fuses from a southern depot and their use against the enemy less than 48 hours after the North African forces placed their radio requisition. Likewise, incoming material that has run into demurrage, because all available labor has been concentrated on handling emergency shipments, receives a higher priority for unloading than railroad cars that have just arrived on the depot.

MASTER ASSIGNMENT SCHEDULE

The assignment of personnel and equipment involves two basic steps: A "master assignment schedule," or "daily work plan," must be set up to record scheduling decisions made. This may be done either on a paper form or a large wall scheduling board as shown in Fig. 9. The setting up of this form includes listing, in order of priority, all outstanding work projects. Because this must include the completion of tasks started the previous day, information concerning the degree of completion of which will not be available until the end of the previous work period, the master schedule is usually set up at the end of the day preceding that for which work is being planned.

STANDARDIZATION OF MATERIALS-HANDLING METHODS

In order to complete the work schedule and show specifically that work which each foreman will perform, the labor and equipment he will use, and the work processes he will follow, it is necessary that the proper work method be determined for the performance of each job listed.

It has been pointed out that, early in the war, many methods were in use at a single depot for the performance of identical tasks. The choice of the work method was then largely dependent on the past experience or ingenuity of the foreman concerned and the type of materials-handling equipment, if any, he was able to assemble for his crew. The first step taken by the Ordnance Department to rectify this condition was to design and standardize a range of fork-lift trucks and warehouse tractors for use in materials-handling operations and to place contracts in such quantities as to insure an adequate supply of this equipment for the average load to be handled at each installation. Recognizing that greatest immediate savings in labor expenditure could be made by developing adequate daily work scheduling, and that this would be delayed if it were withheld until standard procedures for the performance of each operation could be developed by a central agency and distributed for use in all field installations, steps were taken to assist each depot in developing its own standard materials-handling procedures.

Regional training conferences were held at which Washington methods men discussed with depot personnel those problems involved in the design and utilization of standard procedures. From these conferences, a standard production data sheet was developed. The use of this form will be discussed at greater length in the fourth section of this paper; it is pointed out here, however, that it furnished a device whereby depot personnel could record production results for each of the various methods used to perform a single job. Analysis of these sheets permitted determination of that method and gang make-up which consistently resulted in the lowest labor cost per unit of production obtained. In so far as handling equipment was available,

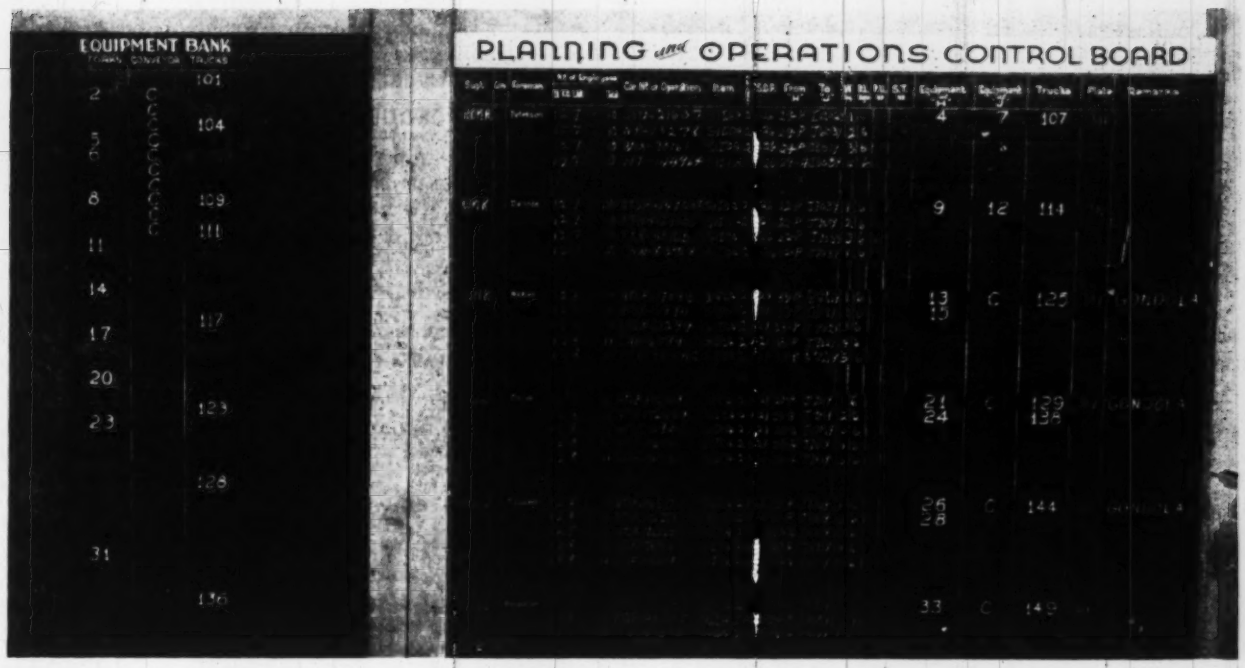


FIG. 9 WALLBOARD VERSION OF MASTER ASSIGNMENT SCHEDULE AS USED AT ONE DEPOT

the depot then standardized upon this method and crew size and used information obtained from the study for daily scheduling.

Over a period of time, depot staff personnel in the Office, Chief of Ordnance, obtained copies of standard operating procedures established by the depots. From this information they determined the most effective method for the performance of a particular job and added it to the growing list of standard operating procedures prescribed for use at all installations.

Addition of a new procedure is now optional for use at the depots for the first 3 months succeeding its publication. During that time depots are urged to submit information concerning any methods they have recently developed, believed to be superior to that prescribed by the central office. At the end of the 90-day period, the standardized procedure is republished in a form incorporating depot suggestions and is then mandatory for use at all Ordnance installations. It should be noted, however, that when an installation can develop and demonstrate an improved method, standard procedures are revised accordingly.

In this manner, without the use of a pilot installation, standardized materials-handling operating procedures have been developed, as illustrated in Fig. 10. All operations have not as yet been covered but it is anticipated that standard procedures will be prescribed completely by early 1946. Procedures published by the Office, Chief of Ordnance, prescribe personnel, equipment, and layout for the receiving or shipping of any particular item or group of similarly packed items. Classification of these procedures is predicated on the conditions under which the work must be performed and the type of handling unit, without regard to the contents of the handling unit. Exception is made to this only when the contents of a package may be of a hazardous or fragile nature, such as explosives for shipment overseas or acids for domestic distribution.

Where an Ordnance-specified standard operating procedure exists, scheduling personnel need only turn to the file of procedures to determine personnel and equipment requirements for the performance of any specific job listed on the "master assignment schedule."

Where an Ordnance standard procedure does not exist, a depot standard procedure will be used. In this case, the person doing the scheduling may use the locally developed technique for the selection of the proper method. One depot has reduced the solution of this problem to a method-selection chart, illustrated in Fig. 11. This chart is designed to facilitate the selection of the method of handling palletized material into, or out of, warehouses, and considers the following four basic factors:

1 *Pallet Factor.* Provision for flat pallets, if rectangular or otherwise easily stacked handling units are involved, or a box pallet where round or irregularly shaped units are concerned.

2 *Package Factor.* Determination of whether one or two men will be required to load or unload the handling units onto, or off, the pallet. If the individual handling unit exceeds 120 lb, has a maximum dimension of more than 3 ft, or exceeds 6 cu ft in volume, the chart indicates that two men will be required. Otherwise, only one man is necessary. In case of hazardous or fragile material, two men would be employed even before the specified weight, dimensional, or volume limits are reached.

3 *Packages per Pallet Factor.* Provision is made for use of different procedures for pallets holding less than 12, 12 to 24, or more than 24 packages.

4 *Length-of-Haul Factor.* Provision is made for use of different procedures for hauls between handling points less than 125 ft and 125 to 250 ft distant.

Scheduling personnel use the method-selection chart as follows:

1 Based on knowledge of handling units concerned, select the indicated portion of the pallet-factor column dependent on whether flat or boxed pallets will be used.

2 Check the weight, cube, maximum dimension, and hazardousness or fragility of the handling unit against limitations set for each of these items and determine therefrom whether the handling unit is a one-man or two-man package.

3 Based on standard storage diagrams, select the indicated column under heading "packages per pallet."

4 Based on knowledge of where the item will be handled,

ORDNANCE FIELD SERVICE DIRECTIVES

STANDARD OPERATING PROCEDURE

FOR HANDLING AMMUNITION

5A8.1
WM CODE 321
3-15-45

TITLE

RECEIVING 250 LB. AND 260 LB. BOMBS
INDIRECT

DESCRIPTION OF OPERATION

BOMBS ARE REMOVED FROM CAR BY FORK LIFT AND PLACED IN TRAILER, TRANSPORTED TO IGLOO AND STORED BY FORK LIFT.

PERSONNEL REQUIRED - 18

1 - FOREMAN
2 - GANG BOSSES
7 - MUNITION HANDLERS
1 - CHECKER
2 - TRACTOR DRIVERS
2 - FORK LIFT OPERATORS

EQUIPMENT REQUIRED

2 - 5 TON TRACTORS
2 - 12 TON TRAILERS
2 - FORK LIFT TRUCKS
1 - BOMB BRIDGEKS
0 - LENGTHS CONVEYOR
0 - LENGTHS CONVEYOR
0 - LE"GTHS CONVEYOR
0 - CONVEYOR SUPPORTS
1 - SET FOREMAN'S TOOLS
8 - PORTABLE SAFETY LIGHTS
2 - CAR PLATES WITH ANCHOR PINS
2 - DUNNAGE TRAILERS
0 - PALLET TRAILERS
1 - IGLOO DOOR RAMPS
DUNNAGE FOR IGLOO
0 - PALLETS

SAFETY PRECAUTIONS

HANDLE AMMUNITION CAREFULLY
CHECK FOR PROPER CONDITION OF OPERATING EQUIPMENT
FIRE EXTINGUISHERS MUST BE ACCESSIBLE AT ALL TIMES
CAR PLATES SHOULD BE SECURELY ANCHORED
BLOCK MATERIEL SECURELY FOR TRANSIT
DO NOT WALK OR STAND ON CONVEYOR
KEEP WORKING AREA POLICED AT ALL TIMES

PERSONNEL FUNCTIONS

1 - FOREMAN DIRECTS AND COORDINATES PLATFORM AND IGLOO ACTIVITIES.
2 - CHECKER CHECKS LOTS, PREPARES NECESSARY DOCUMENTS, KEEPS TIME, AND ASSISTS FOREMAN.
3-4 ROLL BOMBS TO CENTER OF CAR.
5 - GANG BOSS DIRECTS PLATFORM ACTIVITIES, REMOVES DUNNAGE AND ROLLS BOMBS ONTO FORK LIFT.
6 - FORK LIFT REMOVES BOMBS FROM CAR TO TRAILER.
7 - ROLLS BOMBS INTO POSITION IN TRAILER.
8-9 - DRIVES TRACTOR AND TRAILER BETWEEN PLATFORM AND IGLOO AND ASSISTS 7 AND 10.
10 - ROLLS BOMBS INTO POSITION FOR PICK UP BY FORK LIFT.
11 - LIFT TRUCK UNLOADS TRAILER AND STORES BOMBS IN ACCORDANCE WITH APPLICABLE STORAGE DRAWINGS.
12 - SUPPLIES DUNNAGE FOR STORAGE OPERATION.
13 - GANG BOSS DIRECTS IGLOO ACTIVITIES AND TURNS BOMBS FOR STACKERS.
14-15 - STACK BOMBS.

REMARKS

ANTICIPATED EFFECTIVENESS 80 M.M. PER TON

DUNNAGE SECTION DELIVERS TRAILER WITH DUNNAGE TO IGLOO.

DUNNAGE SECTION DELIVERS TRAILER TO PLATFORM.

PERSONNEL FUNCTIONS 7 AND 10 MAY BE PERFORMED BY FEMALE LABOR.

BOMBS ARE LOADED CROSS-WISE ON FORKS, AND ROLL OFF FORKS TO BOMB BRIDGE AND ARE POSITIONED BY 13 FOR 14 AND 15.

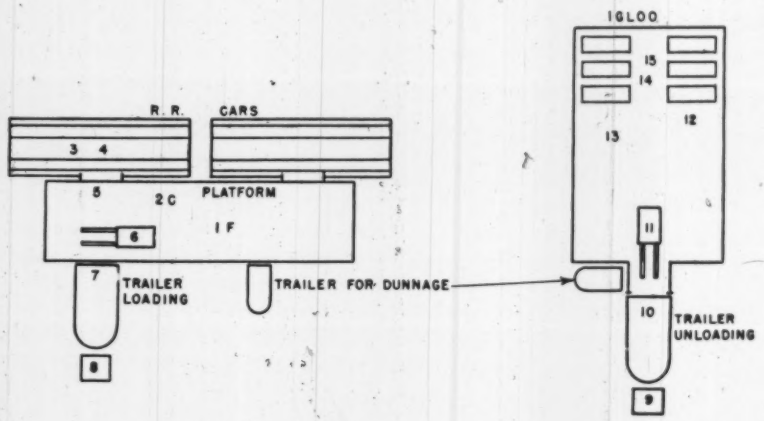


FIG. 10 MATERIALS-HANDLING STANDARD OPERATING PROCEDURE PUBLISHED BY THE CHIEF OF ORDNANCE FOR USE AT ALL DEPOTS

select the indicated column under the heading "length of haul."

5 Only one horizontal line may be drawn through the solid portion of the four factor columns selected on this chart. Following this line to the right of the chart will indicate the code number of the proper depot standard operating procedure.

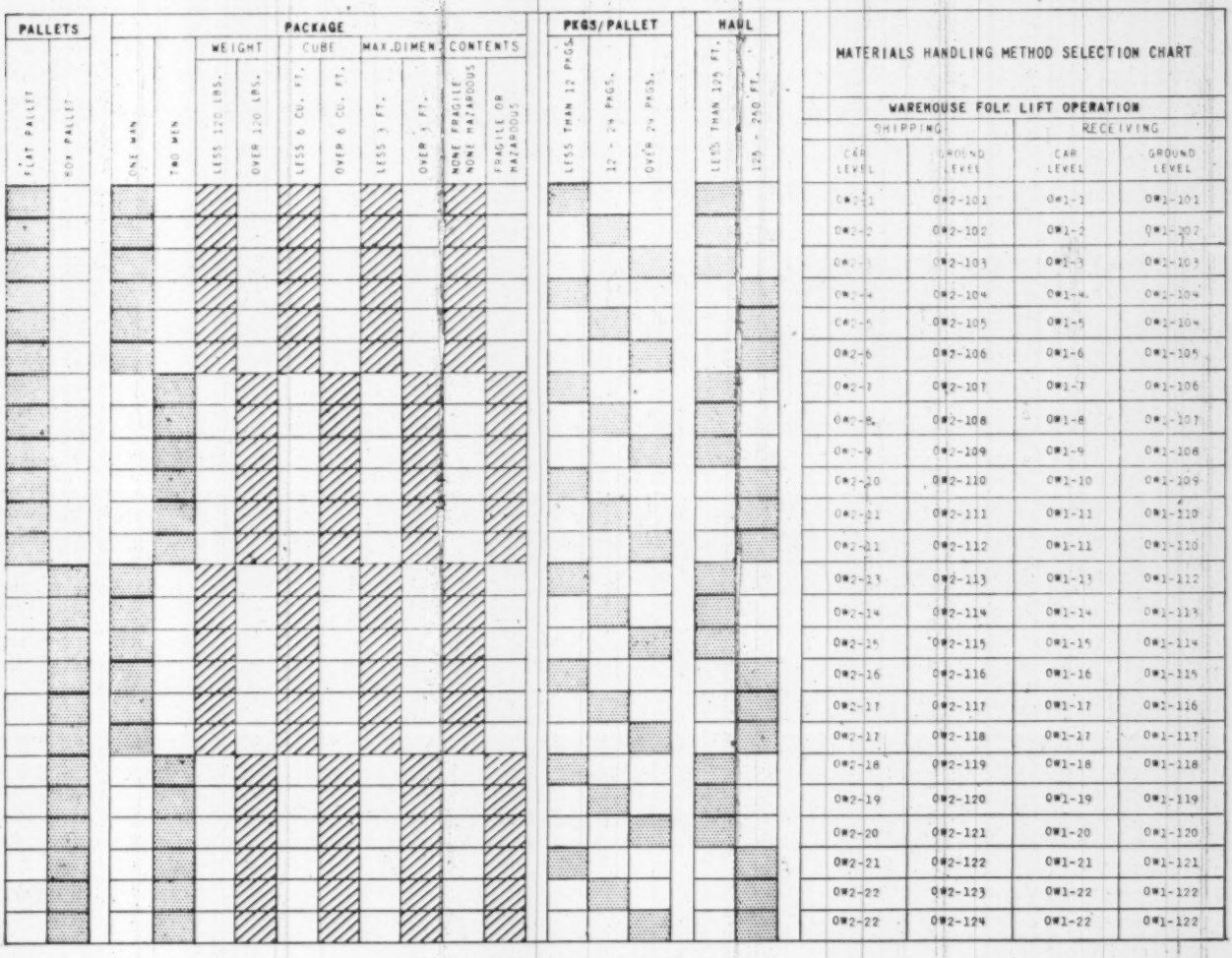
Reference to the method-selection chart, Fig. 11, indicates that, if boxes of rifles were being received for storage on flat pallets and each box weighed less than 120 lb, contained less than 6 cu ft, was 5 ft long, packed so as to be nonfragile, and was to be placed in storage at a point less than 125 ft from the receiving dock, Standard Operating Procedure OW1-7 would be used at a car-level warehouse and OW1-106 would be used at a ground-level warehouse.

The scheduling clerk may be confronted with the problem of having no standard operating procedure, either Ordnance or depot-prescribed, available for use. Under existing conditions, this will rarely occur on receiving or shipping activities but will be primarily limited to a portion of the backlog projects. Accordingly, it is necessary that the scheduling clerk insure that the backlog work-projects inventory is carefully annotated by supervisors as to personnel and equipment requirements and estimated time for the performance of those jobs not covered by standard operating procedures.

LISTING REQUIREMENTS

When scheduling personnel have selected standard operating procedures for each of the jobs listed on the "master assignment schedule," it is necessary to make appropriate entries on a job ticket or work-assignment production-data card, illustrated in Fig. 12. At this stage, information already appearing on the master assignment schedule is copied onto each card, and there is added thereto a listing of equipment and personnel required as well as the location at which the work is to be performed and the amount of work to be done. This information is likewise posted to appropriate columns in the master assignment schedule. With this information available, it is then possible to enter the appropriate foreman's name against those jobs for which he will be responsible. In so doing, it is necessary for the scheduling clerk to convert standard time expended, from man-hours per production unit for each standard operating procedure, to crew hours required for the performance of the volume of work to be performed on each operation, so as to determine the approximate time the given job will be completed.

Assignment of jobs to individual foremen is dependent on locations where the work must be performed and the known ability of certain crews to excel in particular types of work. It is common practice to assign to a particular crew a volume of work known to be slightly greater than can be performed during the scheduled period, the purpose being not to attempt a stretch-out of personnel but, rather, to overcome the unconscious slowing down of work when a backlog is known to exist. This also provides substitute tasks to be done in the event that equipment breakdown or order cancellation requires a last-minute change of assignment, and in general overcomes



MATERIALS HANDLING METHOD SELECTION CHART

WAREHOUSE FOLK LIFT OPERATION

SHIPPING		RECEIVING	
CAR LEVEL	GROUND LEVEL	CAR LEVEL	GROUND LEVEL
OW2-1	OW2-101	OW1-1	OW1-101
OW2-2	OW2-102	OW1-2	OW1-102
OW2-3	OW2-103	OW1-3	OW1-103
OW2-4	OW2-104	OW1-4	OW1-104
OW2-5	OW2-105	OW1-5	OW1-104
OW2-6	OW2-106	OW1-6	OW1-105
OW2-7	OW2-107	OW1-7	OW1-106
OW2-8	OW2-108	OW1-8	OW1-107
OW2-9	OW2-109	OW1-9	OW1-108
OW2-10	OW2-110	OW1-10	OW1-109
OW2-11	OW2-111	OW1-11	OW1-110
OW2-11	OW2-112	OW1-11	OW1-110
OW2-13	OW2-113	OW1-13	OW1-112
OW2-14	OW2-114	OW1-14	OW1-113
OW2-15	OW2-115	OW1-15	OW1-114
OW2-16	OW2-116	OW1-16	OW1-115
OW2-17	OW2-117	OW1-17	OW1-116
OW2-17	OW2-118	OW1-17	OW1-117
OW2-18	OW2-119	OW1-18	OW1-118
OW2-19	OW2-120	OW1-19	OW1-119
OW2-20	OW2-121	OW1-20	OW1-120
OW2-21	OW2-122	OW1-21	OW1-121
OW2-22	OW2-123	OW1-22	OW1-122
OW2-22	OW2-124	OW1-22	OW1-122

FIG. 11 METHOD-SELECTION CHART

FORM NO. 00-729 SPOFT 5 Apr 45

ARMY SERVICE FORCES
ORDNANCE DEPARTMENT

WORK ASSIGNMENT PRODUCTION DATA

2. S.O.P. NUMBER	3. DATE OF OPERATION	4. PAGE NUMBER
5A4,2 Car Dunnage	11-25-44	7275

FOREMAN 4. NAME	5. NUMBER	6. TYPE OF SHIPMENT	7. REQUIREMENTS (a) PERSONNEL		(b) EQUIPMENT		8. LOST TIME	9. NO. EMPL.	10. TIME (a) START	(b) STOP	11. TOTAL MAN-HOURS
Knowles	255	X CL	7	Lab.	2	Forks		10	8:00	12	40
12. OPERATION Shipping		LCL	2	Fork Op.	1	Tractor		10	12:30	4:30	40
		TRUCK	1	Tr. Dr.	3	Trailers					
13. DESCRIPTION OF ITEM RIQNA Shell, H. E., 105mm		EXPRESS									

16. WORK SEQUENCE	17. STATION NO.	18. S/T NO.	19. REASON FOR LOST TIME	14. TIME REPORTING CODES		15. TOTAL LABOR MANHOURS	
				(a)	371-5		(a) 80
				(b)	702	SUPERVISION	(b) 8
				(c)	361	CHECKERS	(c) 8
				20.	TOTAL MANHOURS		96

HANDLING DATA

21. ☐ PRE-PALLETIZED 22. ☐ PALLETIZE AND SHIP 23. ☐ DIRECT ☐ INDIRECT 24. UNIT WEIGHT 25. UNIT CUBIC FEET 26. STANDARD MANHOURS

27. CAR NUMBER	28. CAR OF	29. LOT NUMBER	30. LOCATION	31. NO. PKGS TO BE HANDLED	32. PACKAGES HANDLED	33. TONS	34. CUBIC DIMENSIONS OF CARLOAD	35. COMPLETE Yes	No
ATSF 144628	14	KN-11-44	FROM E 110 TO 35 P	900	900	52		X	
ATSF 144862	15	KN-11-44	FROM E 110 TO 35 P	900	900	52		X	
ATSF 144943	16	KN-11-44	FROM E 110 TO 35 P	900	200	11.5			X
			FROM TO						
			FROM TO						
			FROM TO						
			FROM TO						
36. TOTAL				37. 2700	38. 2000	39. 115.5	40. PRODUCTION REPORTING CODES		

FIG. 12 FORM OF JOB TICKET USED TO ASSIGN WORK TO LABOR FORMEN

variations between scheduled and actual performance rates.

When the master assignment schedule has been completed, it must be analyzed to insure that adequate equipment is available to fulfill the needs listed. In the event an overallocation of equipment has been made, one of two steps may be taken: It may be possible to change the sequence of the performance of certain jobs; or it may be necessary to substitute a more costly method using less materials-handling equipment. If any changes are made in the schedule as a result of this last-minute analysis, corresponding changes must be made in the work-assignment production-data cards.

GETTING MEN AND EQUIPMENT TO THE JOB

The third phase of daily scheduling concerns the translation of the data appearing on the master assignment schedule into actions necessary to deliver personnel, material, and equipment in proper quantities and on scheduled time to the work location.

Equipment Delivery. Action to deliver materials and equipment is initiated immediately after completion of the master assignment schedule. This is done by extracting information from the schedule to prepare a railroad-car spotting request for necessary work by the Transportation Section. The form sets forth the number of cars, the size, exact location, and time required for all movements during the succeeding 24 hours. A similar form is prepared for directing the delivery of materials-handling equipment.

Ordnance has recently added the delivery of one more item to locations where ammunition shipments are being prepared; i.e., prefabricated dunnage. An outgoing carload of 250-lb bombs requires the use of approximately 1000 fbm of dunnage. Early in the war, each shipping dock had its own small lumberyard where carpenters drew lumber and cut and fitted dunnage as the labor crew loaded ammunition into the car. Frequent stoppages resulted while the carpenters performed work necessary to the placing of the next layer of ammunition. Through standardization of dunnage specifications and insurance that materiel was loaded into specified-size railroad cars, it has been possible to effect a large-scale prefabrication of dunnage and assembly of sets required for each type of ammunition and car size that might be used. The scheduling clerk orders the delivery to the loading point of appropriate sets of this prefabricated dunnage in the same manner that he requisitions the railroad-car and materials-handling equipment.

The last job of the scheduling clerk, before he goes home late at night, is to check the execution of the work-assignment production-data card. When the foreman arrives in the morning, he will receive several of these cards describing the work assigned him for that day. It is necessary that each of these cards, Fig. 12, clearly sets forth information covering the following:

1 A description of the operation (space 12).

2 The sequence of performance of the jobs (space 16).
3 Personnel to be used (space 7*a*).
4 Equipment to be used (space 7*b*).
5 Procedure and dunnage (space 1).
6 Work location (space 30).

Personnel Delivery. Early depot operations, particularly in ammunition depots where the work point may be 3 or 4 miles from the time clock, frequently saw an hour pass from the time an employee punched his card until he picked up his first case of ammunition. Part of this was due to the fact that equipment was not available when he arrived at the work location. The other major factor resulting in this delay was caused by inability to instruct the foreman quickly in work to be performed so that he could assemble his crew, place them in a truck or bus, and proceed to the work point. Proper scheduling has permitted the correction of this condition. Personnel loading docks were constructed immediately adjacent to time houses and now, when employees arrive in the morning, they immediately report to their usual foreman, who directs them to the proper waiting truck. A small labor pool is maintained at the loading dock and immediately after the starting whistle, the foreman draws from the pool personnel necessary to fill his skeleton crew to the level indicated on that day's work-assignment production-data cards. Trucks leave the loading dock within 2 or 3 min after starting time, and late workers are assigned to the labor pool for that day; from their point of view an undesirable assignment. Hand tools are issued at the loading dock and, in many cases, hot coffee and sandwiches are available for workers who have had a long trip from home.

REPORTS OF ACCOMPLISHMENT

The last phase of Ordnance scheduling is the obtaining of a record from each foreman of the work his crew performed during the day. This is done by having the foreman enter certain data on each of his work-assignment production-data cards, Fig. 12, prior to turning them in on the way home.

In order to appraise the results and furnish data for general operating reports, the foreman indicates in space 9 the number of persons actually used in a crew and, in space 10, total elapsed time. This permits clerical personnel to obtain total man-hours used in the performance of the work. The foreman also shows in spaces 38 and 39 the production obtained. Finally, to facilitate scheduling of the next day's work, he indicates in column 35 whether or not he completed the assigned task.

The placing of even this slight clerical load on the foreman was resisted by numerous operating people when first introduced, on the grounds that many of the best gang bosses could not read or write. However, this objection has been overcome by having, in such cases, another person of the crew assigned to the performance of this duty.

SUMMARY OF RESULTS

Depots that got an early start in the scheduling program described have shown substantial economies in storage operations as a whole, largely through the reduction of thousands of man-hours usually lost between jobs because of lack of co-ordination between personnel and equipment delivery. Two of the depots that have been leaders in the introduction of proper scheduling demonstrated this by operating at an average performance rate 10 per cent higher than the average of their class prior to general installation of Ordnance scheduling.

FRANCE, 1944

E.C.P.D. IN 1945

Report of the Chairman to the Council and to the Local Engineering Societies and Councils

By EVERETT S. LEE

CHAIRMAN, ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

As we meet again at the close of another E.C.P.D. year, in spite of the urgent demands of the war upon our time and our abilities, I am glad to report another substantial year of E.C.P.D. progress to be added to those years which have preceded us. Our members have been active; our committees have continued to advance their responsibilities; our opportunities have become appreciated by an ever-enlarging group; and our objectives continue to be those to which the engineering profession subscribes and is sincere and eager for their further progression.

It is good that we continually keep these objectives in mind—

To co-ordinate and promote efforts to attain higher standards of education and practice, greater solidarity of the engineering profession, and greater effectiveness in dealing with technical, economic, and social problems.

An immediate objective, now apparently practicable of attainment, is the development of a system whereby the progress of the young engineer toward professional standing can be recognized by the public, by the profession, and by the man himself, through the development of technical and other qualifications which will enable him to meet minimum professional standards.

To attain these objectives we work through our four standing committees and special committees. These are:

Standing Committees

Committee on Student Selection and Guidance
Committee on Engineering Schools
Committee on Professional Training
Committee on Professional Recognition.

Through the standing committees the boy who would become an engineer is found in the high school (Committee on Student Selection and Guidance), is carried through his college life (Committee on Engineering Schools, Committee on Professional Training), and into his junior engineering life, say, up to ten years after graduation from college (Committee on Professional Training), and thereafter throughout his engineering life (Committee on Professional Recognition) to form a logical sequence of participation.

Special Committees

Committee on Principles of Engineering Ethics
Committee on Employment Conditions for Engineers
Committee on Information
Committee on Ways and Means.

Through the special committees opportunity is given to progress specific assignments upon completion of which, with report rendered, the committees are discharged.

COMMITTEE ON STUDENT SELECTION AND GUIDANCE

The Committee on Student Selection and Guidance shall report to E.C.P.D. means for the education and vocational opportunities of engineers in order that only those may seek entrance to the profession who have the high quality, aptitude, and capacity which are required of its members. To this end, the Committee on Student Selection and Guidance reports this year the continuance of the research work, under Dr. W. K. Vaughn, of the Carnegie Foundation, of the Pre-Engineering Inventory whereby students entering the freshman year of our engineering colleges can be tested as to their fitness for the engineering courses. The past year has added 4889 students tested to give a total of 13,982 tested in 25 engineering schools. This is a most important phase of our engineering activity and all engineers should study the report of Dr. Vaughn's work with diligence. The general characteristics of the engineering students presented in this report have significance. Preliminary study of test results indicates that many of these factors bear directly on the success of individual students in the colleges of engineering. As we learn more about these factors and are able to relate them to student ability and accomplishments, examination techniques and guidance functions can be greatly strengthened and improved, thereby improving the whole process of engineering education. This is an opportunity open to every engineer in his local community who will give the time to work with the high schools in his territory to bring a better appreciation of the qualifications of the boy who would become an engineer.

The Committee on Student Selection and Guidance further reports the continued guidance work mainly this year with service men. Agencies for helping and guiding the service man have been set up in the localities throughout our land, and local engineering groups can find plenty to do in aiding these agencies in the special guidance appropriate to the engineering field. The Committee on Student Selection and Guidance has found that the great majority of this work centers in the high school. There it fits in perfectly with the previous and continued high-school work. To this end, the committee has circulated high schools with appropriate pamphlets, and approximately 23,000 copies of "Engineering as a Career" have been circulated this year to bring the total of this publication circulated to 52,000 copies, and for which we have on order 25,000 copies in addition. Here, too, is an ever-increasing opportunity for the local engineering societies to participate right in their own community in their own way.

And do not think, fellow engineers, that there is a surplus of engineers. There is, on the contrary, a mighty deficit. The Committee on Student Selection and Guidance estimates that the need for engineers is such that while in normal years 25,000 freshmen would enter engineering colleges, to meet present needs 65,000 freshmen would have to enter this year. The need for selection and guidance under these conditions is greater than ever.

This year brings to an end the present active chairmanship of President A. R. Cullimore, who as chairman of the Committee

Presented at the Thirteenth Annual Meeting of the Engineers' Council for Professional Development, New York, N. Y., Oct. 19–20, 1945.

on Student Selection and Guidance has brought to this work through his love of students inspiration and accomplishment of great magnitude, and we hail President Cullimore for the outstanding contribution which he has rendered to the work that it may ever be widened to the great benefit of the engineering profession.

COMMITTEE ON ENGINEERING SCHOOLS

The Committee on Engineering Schools shall report to E.C.P.D. means for bringing about co-operation between the engineering profession and the engineering schools. As an intermediate step the committee shall report to the Council criteria for colleges of engineering which will insure to their graduates a sound educational foundation for the practice of engineering. In this committee is centered the accrediting activity of E.C.P.D. to give an accredited list of engineering courses recognized as standard. This has been one of E.C.P.D.'s outstanding accomplishments, and to those engineers who have continuously given of their time to this outstanding work is due our highest praise. During the war years the inspections have been held to a minimum as the committee has believed that engineering colleges could not be fairly judged while operating under war conditions. Even so, during the past three years, 22 curricula at 13 institutions were investigated, and special consideration given to 26 curricula at other institutions. With the resumption of normal activities, the normal accrediting program will be resumed.

This year has seen the active setting up of a complete accrediting regional committee personnel covering our entire country, under the Subcommittee on Technical Institutes for the accrediting of technical-institute curricula. This includes a personnel representation of 125 engineers and educators and is a high tribute to the work of Dean Hammond and the members of the Subcommittee on Technical Institutes, in setting up this most comprehensive and effective group for this important work of the accrediting of technical institutes. This work continues under the Committee on Engineering Schools and we owe much acclaim to Dr. Prentice for the faithful progression of this work and so effectively. The days to come will see the beginning of technical-institute accrediting under the same guiding principles which have made collegiate accrediting an outstanding contribution of E.C.P.D., and so recognized.

A further study of the report of the Committee on Engineering Schools will bring an understanding and a realization of the many calls that come to the committee and of the avenues of activity open. There is still much to be done, and participation of those in local engineering societies interested in the work is open to those who will contribute of their time and abilities to it.

COMMITTEE ON PROFESSIONAL TRAINING

The Committee on Professional Training shall report to E.C.P.D. plans for the further personal and professional development of young engineering graduates and also of those without formal scholastic training. Here is a great opportunity for work with the young engineer as he leaves the engineering school and enters his chosen lifework. And to this end that there shall be a better understanding of the younger engineer and that he may have a proper entry into the profession, the Committee on Professional Training has visualized the "Manual for Junior Engineers" which would state the aims and objectives of the profession and would be in the hands of the professor, the student, the young engineer, the employer, and the older engineer alike, so that there would be a greater mutual understanding on the part of each and all engineers as to the importance of the direct application of such a mutual tie toward the understanding of professional contribution and attainment. The Manual is still in the writing but we hope for its early completion. And we visualize this as a most potent factor in bringing about a better understanding of the know-how of engineering professional attainment and solidarity.

A continuation of the upkeep of the "Reading List for Junior Engineers" is an important objective of the committee and this work is progressing.

Dr. C. A. Pohl has brought to the committee his long experience in engineering and in engineering education to its advantage.

COMMITTEE ON PROFESSIONAL RECOGNITION

The Committee on Professional Recognition shall report to E.C.P.D. methods whereby those engineers who have met suitable standards may receive corresponding professional recognition. This work is necessarily among the engineers who have advanced in the profession and great responsibility rests with them in bringing into being those concepts of the engineering profession which they seek and to which their engineering spirit gives visualization. There is need here for greater response. The report of the Committee on Professional Recognition, under Dean Dougherty, well recognizes this and it is to be hoped that there will be recognition from the engineers of the local engineering societies and councils of the opportunities here for bringing professional recognition into being, based on accomplishment and service. But it will not come about by just talking about it. It will require much individual and collective time of engineers well spent. The Committee on Professional Recognition suggests several projects. It would be good if the local engineering societies and councils would take some time to discuss these and to send their thoughts to Chairman Dougherty for the Committee on Professional Recognition to codify. Such a step would be most constructive, would be far-reaching, and would be an advancement. I especially and specifically bring this subject to your attention as one of the most important for your progression.

SPECIAL COMMITTEES

The special committees of E.C.P.D. are now four in number. The Committee on Principles of Engineering Ethics under the chairmanship of Dr. Dugald C. Jackson is coming closer to an all-inclusive statement. The "Faith of the Engineer," presented by the committee, has been received widely and with sincere appreciation.

The Committee on Employment Conditions for Engineers, under the chairmanship of Van Tuyl Boughton, continues to report the actions in this field.

The Committee on Information, this year under the chairmanship of George A. Stetson, continues to give us good publicity, and at present the committee is progressing a listing of the many engineering societies and groups for the Engineers' Joint Council.

The Committee on Ways and Means, identical in membership with the Executive Committee, has, as the Executive Committee, progressed its responsibilities as to the finances of E.C.P.D., and you will observe from the report the condition of the finances, and, we add, we feel they are good. Study is being given to future opportunities and how these may be best progressed.

CONSULTATIVE COMMITTEE ON ENGINEERING TO THE WAR MANPOWER COMMISSION

During the war, as reported in the past two annual reports of E.C.P.D., we functioned as and through the Consultative

Committee on Engineering to the War Manpower Commission to bring engineering professional thought to the problems at hand and this we did with completeness as has been reported. The terms of the Consultative Committee members as such were terminated in the fall of 1945, but were later reinstated. Further direct participation was postponed awaiting the projected meetings of the Citizens' Federal Committee on Education, set up by Mr. McNutt, Administrator, Federal Security Agency, consisting of twenty-two representative groups, those for the professions being the American Medical Association, the Engineers' Council for Professional Development, and the American Bar Association.

We were thus grateful to be so represented and we have had occasion to believe such representation came about through the results of our participation as the Consultative Committee—thus we were further gratified. However, no meetings of the Citizens' Federal Committee on Education have been called so the whole situation is in abeyance. However, we have demonstrated that where engineers are willing to give of the limitless time demanded for the progression of these activities of which they would be a part, they are granted representation and are recognized, and happily so, for their abilities to analyze and to form clear concise conclusions to advantage are given recognition. So, again, I repeat the thought, the engineers can have those representations for which they ask and those recognitions for which they aspire, but they only come as the result of hard work, applied in view of the service rendered. And this must be by and from themselves.

LOCAL ENGINEERING SOCIETIES

Last year we circulated the Twelfth Annual Report of E.C.P.D. to some 75 local engineering-society groups throughout the land and with it sent copies of the E.C.P.D. "Will You Help?" pamphlet. Also a letter calling attention to the opportunities for local chapters, sections, and branches of the eight particpating bodies of E.C.P.D., together with other local engineering organizations and interested groups to participate in the E.C.P.D. program, specifically through the four standing committees of E.C.P.D. and through the special committees as opportunity offered. The response to our letters has been most substantial in interest and we have supplied in return, upon request, many more of the E.C.P.D. "Will You Help?" pamphlets and a considerable amount of E.C.P.D. literature. To continue this interest I have written this thirteenth annual report to you with the audience of the local engineering societies and councils ever in mind, with the thought that as they receive a copy of this, the thirteenth annual report, they will find themselves specifically in mind and will begin to nurture the local interests of their members in the E.C.P.D. opportunities that these will be brought to the knowledge of every engineer, and that each engineer in turn as he wills to give time and thought to these objectives will do so to the end that greater response of the engineering profession will result. Study of the individual committee reports will bring out these opportunities.

Specifically, there is the opportunity for selection and guidance work in the high schools under the auspices of the Committee on Student Selection and Guidance. Then there is the opportunity for engineering-school-interest participation through the Committee on Engineering Schools. Then there is the opportunity for working with the junior engineer as he is leaving college and entering his life engineering work, and we are hopeful for our Manual as a great aid here. And last, there is that ever-present opportunity for the local engineering-society groups of the land to bring to the Committee on Professional Recognition their thoughts and suggestions and plans for the future of the engineering profession within the charter of E.C.P.D. Here is an opportunity that no engineer can say there was no opportunity if he did not use it. I visualize larger opportunity here—and may much and useful good transpire.

A. R. CULLIMORE AND R. L. SACKETT

And now at the end of this E.C.P.D. year we come to the end of the terms of two outstanding E.C.P.D. producers—President A. R. Cullimore in his work as chairman of the Committee on Student Selection and Guidance, and Dean R. L. Sackett as A.S.M.E. representative on E.C.P.D. and our most active and helpful secretary for this past year. I have asked President Cullimore to speak to us on the counseling of war veterans as a part of the selection and guidance work, and in addition to the report of his committee, I want his talk to be included in our annual report as inspiration to the engineering profession as to the worthwhileness of this work in which each and all can enter and contribute.

As Dean Sackett has been in the E.C.P.D. work since its inception and has brought honor to it, I have personally asked him if he would write for us his concept of E.C.P.D. ahead, and I want it to be included also in our report for inspiration of each of us and of those to follow and of each engineer in the local engineering societies interested in the opportunities ahead.

CLOSURE

And in closing my report I want to thank all who have so well contributed to the work in these busy days; and to all who have preceded us, for their help and inspiration; and to The Engineering Foundation for its continued help through substantial contributions to our work of a research nature.

The history of our work throughout the years is good, our contributions have been substantial, our present position is recognized, and we have proved that engineers can work together in united effort to advantage.

To all I say, how glad I am I am an engineer. I trust and pray that each engineer so sees his chosen profession that he recognizes its great fundamentality, its great achievements, its great potentialities, and that he will give of his time and abilities to making those potentialities into his concept of their realities.

TO organize consciously the machinery of civilization puts a much greater responsibility on human beings than they have had in the past. As long as no one is capable of tracing out the general effects of human actions the most terrible consequences can occur, and no one will be to blame. Indeed, the classical economists had always been able to demonstrate that crises were quite accidental by-products of a fundamentally sound economic system. But once man consciously takes charge of the general organization of production and distribution, the governing powers can rightly be held responsible for any failure. But we are still far from an ordered economic system, planned for the general good, and a long struggle lies between us and its achievement. Nor can the benefits that an ordered society will bring be achieved all at once. The task is one enormously greater than any man has before attempted. That any solution is possible is due only to the development of scientific technique and scientific methods. The technical possiblity of human organization on a world scale is already here. We know how to make the goods, how to distribute them, and how to insure the necessary communications. Even more valuable is the knowledge science has brought as to how to study and measure such a vast and complex thing as the changing needs of a human society.—From "Transformation in Science," by J. D. Bernal, F.R.S., *The Scientific Monthly*, December, 1945, p. 476.

CHOOSING *a* CAREER

How to Discover, Fit Yourself for, and Get the Type of Work That Is Right for You

By ELLIOTT DUNLAP SMITH

PROFESSOR OF ECONOMICS, YALE UNIVERSITY. MEMBER A.S.M.E.

1—HOW CAN YOU FIND OUT WHAT SORT OF WORK IS BEST FOR YOU?

WHEN you secure a permanent job, it is of great importance to get into work that will be the right sort of lifework for you, for your lifework is much more than a means of livelihood. It is a primary factor in the satisfaction and happiness you get out of life, in the service you render society, and in determining how you develop as you mature.

WORK IS GOOD FOR YOU ONLY IF IT LEADS INTO A CAREER THAT IS SUITED TO YOUR CHARACTER, TEMPERAMENT, AND ABILITIES

In each career, day after day and year after year, you repeat certain fundamental sorts of work and get certain types of results. Will these sorts of work and these results give you satisfaction and help mold you into the kind of person you want to become as you grow older?

In each career success depends upon your ability to do certain things. Are these the sort of things which you do best?

Choose your career on the basis of your answers to *these two* questions.

1 Do not let the fact that you have been given some special training determine your choice of a career. Certain careers require specialized training, but the mere fact that you have had that training does not require you to enter that field. It does not even increase your relative chance of success in that field compared to some other field, since the men you will compete with in the specialized field will have as much specialized training as you. To enter most fields does not require specific training, and the man who has had specific training for something else is at no disadvantage in them.

2 Do not be influenced in your choice of a career by the fact that you have been offered, or think you can get, some particular job. In the long run no job in a type of work for which you are unsuited will prove a good job for you. Only after you have chosen your career and are faced with the immediate problems of deciding in what industry and to what companies to apply for a job should the relative opportunities which available jobs provide for progress in your career influence your decisions.

3 Do not be influenced in your choice of a career because you think there is a higher demand for men in some one type of work than in others. It is usually unwise to "speculate on the salary market" in this way. A type of work in which pay is high and which looks like a good one to get ahead in today, may be very crowded and slow a few years later, and you are choosing a lifework.

TO FIND OUT WHAT LIFEWORK IS RIGHT FOR YOU, TAKE THE STEPS LISTED BELOW OR IN THE ALTERNATIVE PLAN WHICH FOLLOWS

1 Make a list of all the careers you might possibly want to enter and for which by any chance you might be qualified.

Don't divide careers too narrowly. Stick to the main careers such as teaching, fine arts, law, medicine, journalism, selling, trading, and merchandising, finance, personnel administration, management, office management, technical operation, research and design, and military service.

Except for the professions and military service most of these careers may be pursued in such diverse fields as manufacturing, transportation, real estate, banking, insurance, entertainment, hotels, and hospitals. It is usually best, however, to select the main type of work which you want to make your career first and not to narrow it down to special fields until you are sure of that.

2 Cross off, one by one, those careers that are definitely out until you have reduced your list to the two or three that seem best.[1]

Do not hurry. If you eliminate one each week it is fast enough. But until you have reduced your field of choice to two or three, you are in no position to make the thorough study essential to a wise choice.

3 Find out all you can about what the few careers you have selected require and provide.

(*a*) What are the sort of things you will be doing day after day?

What will be your principal tasks? What subordinate things must you do in accomplishing them? For example, if you have selected selling as one of your alternative careers do not assume that the obvious work of calling on customers and presenting your product to them is all that selling involves. Instead ask yourself such questions as, must I travel extensively, will much of my work consist in figuring, must I analyze mechanical or other problems, must I constantly take risks because I am paid on commission, etc.?

(*b*) What will the environment of your work be?

Where will you work? What sort of people will you be among and what will your relationship to them be? How will it affect your home life, etc.?

(*c*) Where does the work lead and how will it change as you grow older?

It may not be easy for you to find the answers to these three questions, but it is important and possible to dig them out for yourself. Good books on what people do in the various careers, even biographies that are frank and reliable, are rare, but they are worth searching for. Trade journals may help.

The best source of information is asking people in the fields you are interested in just what they do, what it takes to do it well, what they like and dislike about their work, and why.

[1] If you are in the Army, Navy, or Marines, do not cross off military service too readily. There is an unthinking tendency at present to feel that now the war is over, you should leave the Armed Forces and enter a peacetime career. The Army, Navy, and Marines are peacetime occupations and will provide the best ones for many men now in the Armed Forces. Remember that you must investigate their peacetime possibilities just as much as those of any type of business, before you know all they have to offer.

If you have persistence, somehow you will get at the facts and in the process of finding them out for yourself you will get a fullness of understanding that no one else can give you.

4 After you know what the few careers, you have selected provide and what they will require you to do, ask yourself how well you are suited to each.

(*a*) Think out the principal qualities it is important to have in order to succeed in doing well each part of the work of each job and how fully you possess those qualities.[2]

(*b*) Examine your past experience and see if you can find instances which indicate whether or not you were right in your estimate of your ability. Get down to "brass tacks" on this.

For example, if success in a career which you are considering involves much analysis of documents, think of the most difficult reading you have done as a basis for solving a problem, what difficulties it involved, and how successful you were.

[2] Table 1 which lists the principal qualities required, and the satisfactions rendered by the main careers, may be of help in doing this.

(*c*) In the same way, think out concretely how much you will enjoy what you will do in each career and the environment which each career[2] will provide; and how much satisfaction these will give you. Again, look at concrete instances.

For example, if you are considering the college teaching of chemistry as a career, and know that success will involve devotion to research, think over the time you have spent in the laboratory. How far did getting your measurements painstakingly exact excite you and make you want to stay on? How much satisfaction and sense of accomplishment did it give you to repeat an experiment and get a result somewhat more precise than before?

(*d*) Compare the suitability to your abilities and personality of the few careers you have examined and decide which one is your first choice. In doing this remember that your qualities are not fixed but subject to development, and consider how much you can develop qualities in which you are deficient.

(*e*) Work up what you have thought out into a brief clear

TABLE 1 RELATIVE QUALIFICATIONS OF THE MAIN INDUSTRIAL CAREERS

Qualities needed	Careers: R&D	TC	B	F&Tr	S	M	FP	CT
Physical:								
Force or appearance	..	..	..	..	2b	2b*	2b	..
Resistance to disease	2a	2a	2a	2a	2a	2a	2a	2a
Resistance to poor diet	..	..	..	2b	1a	..	..	..
Resistance to hours and strain	*	2b	2a	1a	2a	2a	..	..
Dexterity, sensory, manual	1a	2b	..	..	..	2b	..	..
Vision with glasses	2a	2a	2a	2a	2a	2a	2a	2a
Intellectual:								
General intelligence power	..	..	1b	1b	..	1b	1b	1a
Common sense	..	2b	1b	1b	1b	1a	1a	2b
Shrewdness	..	..	1a	1a	2a	2a	2a	..
Precision and thoroughness	1a	1a	2b	2a	..	1a	2b	2b
Special aptitudes (for that work)	1a	2a	..	2b	..	2b	..	1a
Imagination in that field	1a	..	2b	..	2b	1b	1b	1b
College education; general	2b	2b	2b	2b	2b	2b	2b	2b
College education in that field	1a	2b	..	2b	..	..	..	1a
Character:								
Integrity	2a	2a	2a	2a	2a	1a	2a	2b
Determination	2a	..	2a	2a	1a	1a	2b	2b
Poise in face of: Uncertainty	..	..	2a	1a	2a	2b	..	..
Opposition and excitement	..	..	1a	1a	1a	2a	2b	..
Criticism from colleagues	2b	2b	2b	2a	..	1a	2b	..
Criticism from outsiders	..	..	2a	..	1a	2b	..	..
Contacts:								
Pleasantness with associates	2b	2a	2b	..	..	1a	1a	2a
Pleasantness with outsiders	..	..	2b	2b	1a	..	2a	..
Influence over associates	2b	2b	2b	2b	2b	1a	1a	2a
Influence over outsiders	..	..	1a	2a	1a	2b	2a	..
Interest:								
In subject matter	1a	2a	2b	2b	..	2b	..	1a
In type of work	1a	2a	2b	1a	2a	2b	2a	1a
In people	..	2b	..	..	2b	2a	1a	2a
Desires that are satisfied								
Job:								
Early self-direction	2	..	1	1	1	2	2	1
Absence of desk routine	2	..	1	1	1	2	1	2
Absence of contact routine	1	2	2	1	..	2	2	1
Absence of financial risk	1	1	2	..	2	1	1	1
Early financial returns	..	..	1	1	1	..	2	2
Social:								
Social prestige	2	..	2	2	2	2	2	1
Social life not dominated by work	1	1	2	2	..	2	2	1
Chance to win distinction	1	..	2	2	..	2	2	1
Inner satisfactions:								
Human service	..	..	..	..	..	1	1	1
Intellectual achievement	1	2	..	..	..	2	2	1
Competitive excitement and success	..	..	2	1	1	..	..	..

EXPLANATION OF ABBREVIATIONS:

Amount needed of a quality: 1 = high degree; 2 = normal amount.

Importance of a quality: a = essential; b = valuable; * = more is needed in certain fields.

Abbreviations of careers: R&D — engineering research and design; TC—technical operation control; B—buying or purchasing; F&Tr—finance and trade; S—selling; M—managing; FP—functionalized personnel administration; CT—college teaching.

statement which gives both your conclusions and the main evidence in support of them. When you have done this you can forget your career for a while and still not lose the value of what you have done.

For many men it may be better to reverse the order of this analysis of what job is right for you, and pursue the following alternative plan:

1 Think over the things you have done and what they indicate about your abilities and about the type of work and work environment that give you satisfaction.

2 Put your conclusions, both as to your abilities and as to your sources of satisfaction, down in a well-organized, well-written outline. (The topics listed in Table 1 may help you in organizing your conclusions.)

3 Check each conclusion on your outline by a careful review of the evidence which your past experience gives as to its validity and make annotations and changes accordingly. (See 4(*b*) and (*c*) in the preceding section.)

4 Make a list of the careers you might want to enter and for which by any chance you might be qualified. (See 1 in the preceding section.)

5 Cross out one by one those careers that are definitely out. (See 2 in the preceding section.)

6 Find out all you can about what the few fields you have selected require and provide. (See 3 in the preceding subsection.)

7 Compare your conclusions about your abilities and sources of satisfaction with what is required and provided by two or three of the careers you have narrowed down to, and reach a decision as to which one of them is best suited to your temperament, character, and abilities.

8 Write down your final conclusions and the evidence in support of them in a compact outline.

Neither of the foregoing plans of analysis is better than the other. The one you should use depends upon which is better suited to you. Probably most men will try both ways informally in their own minds before they undertake to make a really careful analysis. But persevering until such an analysis has been completed is thoroughly worth while for all.

In doing this, don't lean too heavily on others. Think everything out for yourself before getting advice. Even then, make up your own mind. You cannot delegate to others, even experts or parents, your responsibility for your own competency or for making your own major decisions.[3]

Where will all this hard work have got you?

You will have thought out as far as it is possible to do so in advance, what is the right sort of work for you.

You will know what qualities it is important for you to develop and, as a result, you will be more likely to develop them as you do your work, whether in college, in the service, or on the job.

You will be in a much better position to get the job you want when the time comes, both because the first requirement of good salesmanship is a knowledge of the product you are trying to sell, and because employers know that a man who has thought out carefully what he wants and is qualified for is a better hiring risk than a man who "will do anything," and who, whenever the going gets hard, is likely to think he is suited to something else and leave.

II—WHAT QUALITIES IS IT IMPORTANT FOR YOU TO DEVELP IN ORDER TO PREPARE YOURSELF FOR YOUR CAREER?

It is important for you to find out now what these qualities are, so that you can develop them as far as possible before you need them to get the job you want and to succeed in it.

THERE ARE SPECIAL QUALITIES NEEDED FOR YOUR CHOSEN CAREER

These qualities you will have already discovered through making the analysis on the basis of which you chose your career.

THERE ARE EQUALLY IMPORTANT GENERAL QUALITIES THAT UNDERLIE SUCCESS IN ALL CAREERS, THE MOST IMPORTANT OF WHICH ARE AS FOLLOWS

1 Capacity for sound, resourceful, well-ordered thought, both in learning from books and from experience, and in using what you know in solving problems. This capacity includes the following:

(*a*) The ability to define a problem clearly for yourself and to devise your own means of solution, rather than merely to make routine analyses.

(*b*) The ability in all thinking and learning to combine the use of formal knowledge learned from books with the use of common sense and practical knowledge acquired from experience.

(*c*) The ability to deal with abstractions, large ideas, and refined conceptions, both in your special field and in understanding scientific, social, and human phenomena.

(*d*) The ability to use English accurately, clearly, and forcefully, as a means of clarifying thought and of communicating it to others.

2 Capacity for working with, managing, and dealing with others forcefully, shrewdly, agreeably, and with consideration. This involves understanding others, not only intellectually, but with one's heart. A person whose understanding of others is coldly intellectual enlists neither co-operation nor respect.

3 Character:

(*a*) Integrity, especially complete honesty.

(*b*) Poise, both under excitement and under protracted strain.

(*c*) Modesty, especially in willingness to learn from others even when they are less educated or are less sophisticated socially than you.

(*d*) Perseverance, both in overcoming difficulties, and in keeping on until a job is completely finished.

4 A mature, well-informed, stable interest in your job, and enjoyment of the type of work, activity, environment, and attainment it involves.

III—HOW CAN YOU DEVELOP THE QUALITIES NEEDED FOR YOUR CAREER?

The time to begin developing these qualities is now.

Any well-taught college course of study, regardless of whether it is technical, scientific, or liberal arts, gives an opportunity to develop the general intellectual qualities that are valuable in all careers, provided that the student makes it his responsibility to do his course work in such a way as to exercise them.

The other general qualities, and in large measure also the intellectual ones, must be developed primarily by learning from experience. But you can start learning from experience

[3] There are some psychological tests of aptitude and of interest that, if you are seriously perplexed, might give you help provided they are skillfully given and cautiously interpreted. But complete your analysis first to the best of your ability. Then if you are still so puzzled that you feel tests are needed keep away from the people who claim that they can tell you what you are best suited for. Instead get a good doctor or university professor to recommend a reliable test psychologist and go to him. Remember that even then you will have to use your own judgment as to what is best for you, since no test can give you more than a few indications to balance with others in making up your own mind.

whether you are in college, in the Armed Forces, or in any preliminary occupation; and unless you start learning from experience now, you will find yourself unlikely to learn well from experience on the job.

WHILE IN COLLEGE THE FOLLOWING WILL HELP YOU TO DEVELOP THE QUALITIES NEEDED FOR SUCCESS IN YOUR CAREER

1 Choose your career analytically as previously outlined. This is the basis for all other preparation and learning.

2 Discover and take the courses which will do most to develop the qualities needed in your lifework, and to make it a career which expands your mind and spirit and contributes to the common good.

(*a*) Certain courses, regardless of subject matter, will do this because of the character of the men who teach them and the manner in which they are taught.

(*b*) Regardless of what career you choose, it will be of value to take courses which develop ability to deal with problems which involve mathematics, physics, economics, or psychology; ability to make a historical approach to a problem and to view it in the light of the history of western civilization; and ability to speak and write with compact force and complete precision and do so with consideration of the person addressed. For every career also it will be of value to take courses which develop effective habits of enriching your life and expanding your spirit beyond the confines of your work by good reading or by some form of artistic appreciation.

(*c*) For each particular career there may be special fields of learning, as well as special qualities, which require emphasis. In the professions these are usually cared for by the professional course of study. In preparing for other careers these fields must be discovered by the student himself and proper courses taken.

For example if you plan to manage or sell in concerns making technical products, it is important to carry your study of science through physics and chemistry to their basic application in engineering and to carry your study of economics at least through a second year.

(*d*) In choosing all courses in relation to your career, select those which you think will do most to ground you in the fundamentals and best train you to use them in future learning and problem-solving, and shun courses which merely give you "practical" applications or techniques.

Such advance solutions of practical problems are likely to prove out of date by the time you come to use them, and such routine techniques are more likely to hold you at a subprofessional level than to assist you to rise to a position of professional judgment and responsibility.

College education which only teaches you what you can better learn at the time of need is detrimental. Education is valuable primarily if it expands your mind and spirit, increases your sense of social responsibility, and develops your ability to learn for yourself and to make wise independent judgments, as you meet problems and rise in your profession. Whether a course does this depends as much upon you as on the course and its instructor.

3 Pick out special courses and special papers or problems to use as examples of the best work of which you are capable in thought and statement. There isn't time to do your best thought and statement on all your course work. Unless you pick out special courses or assignments for this, you probably will never do it.

BOTH IN COLLEGE AND AFTERWARD THE FOLLOWING WILL PROVE OF VALUE

1 Each year—preferably on your birthday so you won't forget to do it—invest a small sum (say $10 to $25) in really outstanding books in a wide range of fields and both read them during the year with care and reflection, and write a careful appraisal of each book or a discussion of its point of view.

Reading gives you an opportunity to expand the range and dignity of your thought by meeting great minds, but only through writing can you get the best out of this meeting of minds in developing not only power of self-expression but also power and range of thought.

It is especially important to pick some books that present viewpoints different from your own, and with such books it is especially important to make sure that you have fully grasped the author's facts and reasoning.

2 In some of your correspondence (to your father or to some friend, for example) try to write exceptionally well.

3 Pick certain times to engage in good talk on serious subjects.

Form a discussion club, pick some special meals, or in some other way find a recurring time when you try to put important and difficult thought into clear, exact, persuasive speech.

Try to include among the people with whom you talk seriously some who are widely different from you in point of view, in background, in experience, and in age.

4 Keep a "What I have learned from experience" journal, making entries every two weeks during your first three months and every month thereafter.

Enter in it each time the one or two outstanding experiences from which you have learned something about management, human relations, engineering, etc. Get down concretely and exactly what the conditions were, what was done, and what happened. If you were personally involved in the experience, note how it affected you. Analyze these facts with great care to make clear just what the reasons for the results were, and just how any mistakes could have been avoided.

Note carefully any special conditions and just how these conditions affected the results. For example, if you are in the Armed Forces note that your men live together and are under discipline 24 hours a day, cannot quit their jobs, and have no unions, and just what effect this had on the case you are recording. This is of great importance if your present experience is to be a help and not a handicap to you in your career. You will surely make mistakes unless you are prepared to notice and adjust to whatever things are different when you get on the job.

In making entries in your journal, make what you write the best example of which you are capable of well-ordered, resourceful thinking, and of clear, exact, forceful English.

5 From time to time, plan and make a systematic survey of your work or some special aspect of it, recording the results as outlined.

TO MAKE COLLEGE, MILITARY, OR OTHER PRELIMINARY EXPERIENCE A SOUND BASIS OF DEVELOPING THE QUALITIES NEEDED FOR YOUR CAREER, HOWEVER, IT IS IMPORTANT TO EMPHASIZE THREE THINGS

1 Self-education and self-direction:

(*a*) In college you are "the product." It is the primary task of the faculty to see that you learn, and you get used to assuming this. In business you are no longer "the product." Everyone is concerned with getting results, and if you are going to develop, it must largely be through self-education both from study and from experience.

(*b*) In college you are usually assigned short specific problems and often told how to do them. In industry a large part of your value consists in your ability to discover problems from small, inconspicuous signs, before they become serious. It is also up to you to work out your own means of solution.

2 Competitive attitude:

(*a*) In competition you must take risks, for if you wait until there is little or no risk, others will be ahead of you. Yet you must always take pains to avoid unnecessary risks by doing everything you can to insure success.

(*b*) In competition you must be willing to do a great deal for a small improvement, since often a small improvement will make the difference between success and failure.

In this connection, you must be willing to prepare for all the things that may happen, even though you know most of them won't happen.

(*c*) In competition your character and your capacity to work considerately with others must be so solid that they will stand up against far greater temptation and strain than is provided by the softer social standards and conditions of college.

3 Professional attitude:

(*a*) A competent professional man is characterized by a disciplined "style" of thought. He neither follows a routine nor gets his results "just any way." Instead, he uses "good form" resourcefully as a means of increasing the effectiveness of his originality and develops it into a disciplined "style of thought" of his own.

Your style of thought should have the same qualities as your style of play in your favorite sport. It should have good form, but the form, rather than cramping you, should give you greater freedom and power.

(*b*) The range of interest and trained thought of a professional man extends far beyond his courses or his work. He is a man of full habit, who carries on independent study that rounds out his intellectual powers.

(*c*) A professional man develops a vital interrelationship between his life and his lifework that makes each expand and enrich the other.

All of the qualities important in your career can only be developed effectively by putting them to use either in ways such as those just suggested, or in other ways of your own devising suited to your particular qualities and temperament. If you try all of the time to develop all the qualities which you need, however, you are likely to do it none of the time. Consequently, it is important to pick special occasions to employ special measures. If you do this regularly, it is astonishing how much progress you can make, and how, when you enter upon your career, you will find yourself standing out from the general crowd. But it takes perseverance.

IV—DO YOU NEED FURTHER EDUCATION?

THE FOLLOWING CAREERS REQUIRE SPECIALIZED FORMAL TRAINING, USUALLY IN GRADUATE SCHOOL. IF YOU HAVEN'T HAD THIS TRAINING, GET IT AS SOON AS YOU CAN

Ministry, medicine, law, the Armed Forces, architecture and the fine arts, technical engineering, office technique (such as accounting or statistics), scientific research, college teaching.

The value of professional education varies greatly. It depends primarily upon how well the instruction the school gives and the way you study, develop not only the special qualities needed for your profession but the general qualities outlined as vital in all careers. Choose your professional school and do your study with this in mind.

THE FOLLOWING CAREERS DO NOT REQUIRE SPECIFIC TRAINING, ALTHOUGH A GOOD ACADEMIC OR TECHNICAL COLLEGE EDUCATION IS HELPFUL IN ALL

Selling[4] *(wholesale or retail commodities, insurance, securities, etc.); advertising; trading (in securities, in real estate, or in commodities); finance and banking; personnel work; management*[4] *(factory, transportation, insurance, office, store, hotel, or hospital); journalism; school teaching;*[5] *government service.*

For the careers on this list as distinguished from those professions on the first list of this section, there is little you can learn from books or graduate study that can make up to you for even a slight impairment of your open-mindedness, your habits of thinking things out for yourself, or your eagerness to learn from experience on the job from the bottom up.

Graduate study, whether business, technical, or academic, may develop habits of relying upon learned techniques and answers, instead of feeling responsible to think things out from basic principles for yourself. Overmuch book study may also make you less sensitive to the subtle opportunities that are hidden in daily work to learn from experience and to discover and attack problems before they become serious.

If you have been in the Armed Forces, the fact that the government pays your educational expenses does not in itself make it wise to return to college or to study in graduate or business school. The government cannot compensate you for the time lost, or prevent the time spent in study from affecting your way of thought and attitude.

Any loss of time when you could be learning on the job and any stiffening of your mind by too protracted education is more serious the older you are.

Graduate education in all the fields on the second list, with the possible exception of *finance* and the graduate study of your subject if you plan to go into *school teaching*, is an investment of time which you should make with caution. Carefully consider whether in your case and in your particular field the additional training you may get will make up to you for the loss of time and the possible impairment of those general qualities of mind and character that are essential to success.

V—HOW TO LOOK FOR A JOB WHEN THE TIME COMES

WHEN YOU ARE READY TO START, PICK THE INDUSTRY YOU WOULD LIKE TO WORK IN AND THE COMPANIES YOU WOULD LIKE TO WORK FOR

In doing this, consider the openings available in your chosen career. What is important is not the starting salary but the opportunity to learn and to progress.

In doing this, pay particular attention to the character of each company you consider. Has it the kind of people as executives that you will want to work with? Is the way it treats its employees, its customers, its competitors, its community, something you would desire and be equipped to participate in? Are its jobs the type that are suited to your abilities? For instance, in some companies, especially large ones, until one reaches a high level most jobs are specialized and call for a restricted group of abilities, while in other companies in the same field the jobs may involve responsibilities calling for general abilities, common sense, judgment, and risk-taking almost from the start. Find out all you can about each company you choose. You cannot find out too much.

REVIEW YOUR CAREER ANALYSIS, CORRECT IT, AND MAKE SURE THAT YOU KNOW WHAT YOU WANT, WHAT YOU HAVE TO OFFER, AND WHAT EVIDENCE THERE IS OF BOTH

Boil this all down into a very compact statement of your record and its relation to the abilities and qualities required, in such a form that you could show it to any prospective employer.

Remember this is very different from a statement that would

[4] A basic engineering education is helpful but not necessary, if the work is in an engineering industry.

[5] Because of state and other regulations as to teacher training two courses in "education" should be taken before starting, or in summer vacation.

be satisfactory for you. You must never praise yourself, or make claims. You must find evidence that will be convincing to the employer. With certain qualities, the only evidence which will be suitable or convincing will be the way in which you state your record, not the record itself. Unless you are careful, the way you state your record may unconsciously suggest that you have undesirable qualities such as lack of good judgment as to what is important, lack of analytical ability, incapacity to use English clearly, forcefully and correctly, lack of tact, etc.

PREPARE YOURSELF CAREFULLY FOR YOUR INTERVIEW

First make a list of all the questions the employer may possibly ask.

Then work out orally, clear, sound, two or three-minute answers to each of these questions.

(*a*) Do this using evidence that will be convincing to the employer and in terms that demonstrate your ability to think and to deal with people.

(*b*) Especially puzzle out how the way you handle yourself and answer questions can show him through your behavior that you are the sort of person he wants.

Do not write your answers down or plan a stereotyped approach. You will have done all the writing it is wise to do in preparing the statement of your record. In an interview you must be flexible and adjust yourself to the interviewer and writing out answers may impair your ability to do this. All that you do in preparation must be done in such a way as to make you more flexible and enable you to adjust to him.

GET AN APPOINTMENT WITH THE RIGHT MAN

If appropriate, write a letter asking for an interview.[6]

If you have experience that justifies you in looking for a job well above the starting level for college graduates, it is important to get your case to the attention of someone high enough up in the company not to treat it in a routine manner. Often the best way to do this is to get someone who knows an important officer of the company to write you a letter of introduction.

GO TO THE COMPANY

Remember that it is the employer's job to run the interview, but that just on that account you must be prepared to answer whatever questions he may ask from whatever angle he may ask them. Do not even hand him your written statement unless the interview has developed so as to make it the best way to sum up your answers to the employer's questions.

Remember that it is nonetheless up to you to make your own case. The employer will be watching to see how well you use the openings which the interview provides to state and demonstrate the qualities which the position requires.

Remember that the employer will be watching especially the qualities you demonstrate by your conduct and that there are no tricks that do anything but harm.

Put your case genuinely, modestly, and forcefully before him.

[6] See "Letters Applying for a Job," by Elliott Dunlap Smith, MECHANICAL ENGINEERING, vol. 67, 1945, pp. 847–848.

Victory Through Air Power

(*Continued from page 6*)

life. The danger zone of modern war is not restricted to the battle lines and adjacent areas but extends to the innermost parts of a nation. No one is immune from the ravages of war.

With present equipment, an enemy air power can, without warning, pass over all formerly visualized barriers or so-called "lines of defense" and can deliver devastating blows at our population centers and our industrial, economic, or governmental heart even before surface forces can be deployed. Our own Air Force, when mobilized and deployed, would have a similar capability and might attack an enemy within hours instead of the days, weeks, or months, required by surface forces.

In any future war the Air Force, being unique among armed services in its ability to reach any possible enemy without long delay, will undoubtedly be the first to engage the enemy, and, if this is done early enough, it may remove the necessity for extended surface conflict.

Air superiority accordingly is the first essential for effective offense as well as defense. A modern, autonomous, and thoroughly trained Air Force in being at all times will not alone be sufficient, but without it there can be no national security.

In the future we must anticipate that aircraft, either with or without pilots, will move at speeds far beyond the velocity of sound, well over 700 miles an hour.

Improvements in aerodynamics, propulsion, and electronic control will enable unmassed devices to transport means of destruction to targets at distances up to many thousands of miles. However, until such time as guided missiles are so developed that there is no further need for manned aircraft, rebe perfected by target-seeking missiles. Under these circumstances only aircraft moving at extreme speeds will be able to penetrate enemy territory protected by such a system of defense.

From what we have already seen, especially in the closing phases of World War II, I think it is obvious to all that fully equipped air-borne task forces will be able to strike at far distant points and will be totally supported by air.

Regarding atomic energy, I believe that its influence on air power can be stated very simply. It has made air power all-important. Air power provides not only the best present means of striking an enemy with atomic bombs, but also the only available protection against the misuse of atomic explosives.

The atomic weapon thus makes offensive and defensive air power in a state of immediate readiness the primary requisite of national survival.

The spectacular innovations in technological warfare which appeared with ever-increasing momentum in World War II and culminated with the atomic bomb must make it clear to all of us that scientific research to insure the maintenance of our national security is vital.

I believe it is in the national interest to establish a National Research Foundation composed of the most highly qualified scientists in the United States and charged with the responsibility of furthering basic research and development in all search in the field of "conventional" aircraft of improved design must be pursued vigorously.

It is possible that a defense against present-day aircraft may fields of science, and the scientific training of adequate numbers of highly qualified men. Scientific planning must be years in advance of the actual research and development work. The Air Force must be advised continuously on the progress of scientific research and development in view of the new discoveries and improvements in aerial warfare.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to original sources is given.

Education

THE Massachusetts Institute of Technology has announced the receipt of half a million dollars for the establishment of a gas-turbine laboratory for graduate instruction and fundamental research in that field.

OHIO STATE

The College of Engineering at The Ohio State University has announced that five-year curricula will replace all four-year curricula in the degree-granting departments of the college. The change will make it possible to bring more so-called "cultural" courses into the engineering curricula.

RENSSELAER

Rensselaer Polytechnic Institute opened, on November 1, a program of co-ordinated evening courses leading to baccalaureate and graduate degrees as well as courses in independent subjects, all in a wide field covering engineering, science, management, English, literature, history, and economics. A co-operative plan with industry to aid in replenishing the nation's supply of scientific and technological personnel has also been announced by R.P.I. The General Electric Company has agreed to participate in training as many as eighty men at a time as its share in the program, and other nationally known companies are said to be making arrangements to take part in the program.

After two and one-half years of study Rensselaer Polytechnic Institute has set up postwar engineering curricula "adjusted and developed in line with the scientific and social and economic changes coming out of the war." It is said that in addition to providing courses which "will train students to become proficient engineers and scientists in newly expanded scientific and technological fields, the new curricula aim to help students understand their duties as intelligent citizens in an era imposing wider responsibilities. Time allotted for the study of such subjects as economics, history, psychology, literature, and other nontechnical courses is increased by one third. Study of mathematics, the sciences, and other fundamental subjects is also increased, and specialization is modified in the belief that the college hours of the undergraduate can be more profitably spent in enlarging his comprehension of all the roots of engineering rather than narrowing down too much to those of a special field."

BROOKLYN POLY

The Polytechnic Institute of Brooklyn has revised its electrical-engineering curriculum to include a series of courses in the fields of electronics. As a result of major developments in the field of electrical engineering the undergraduate course will present two options, the first featuring electrical power and industrial applications and the second, electronics and communications.

NEWARK

Two conferences on engineering for improved distribution were recently held at the Newark College of Engineering in co-operation with the Northern New Jersey chapter of the American Marketing Association and the Industrial Marketers of New Jersey.

Effective Jan. 1, 1946, a reorganization plan at Newark College of Engineering establishes the humanistic-social and the technological divisions on the same level with the degree-granting departments of electrical, civil, mechanical, and chemical engineering. The humanities as taught by the College place emphasis on "the human problems which engineers will be likely to encounter in their professional careers." The technological division deals with the fundamental scientific subjects basic to all fields of engineering, such as mathematics, physics, and mechanics.

STEVENS

Plans have been announced by the Stevens Institute of Technology for the Stevens Research Foundation, "a nonprofit corporation that will serve industry by carrying out research of a more fundamental nature than is customary in most company laboratories." The Foundation will be managed by Dr. Edwin G. Schneider as executive vice-president. At the time the announcement was made in November, $55,000 had been donated to the Foundation's "Venture Fund." Suitability of projects will be passed on by an advisory committee.

BUFFALO

On Nov. 5, 1945, the University of Buffalo broke ground for a new engineering building. The building is planned in three sections, only one of which, the center, will be constructed at this time. This will be four stories in height, with a one-story laboratory extension in the rear, which will house the mechanical-engineering laboratory having 7000 sq ft of floor space. The ground floor will contain an instruments laboratory, fuel and lubricants laboratory, machine-tool and production-inspection laboratories, and two classrooms, designed for the use of visual aids. The first floor will be equipped with a heat-treatment laboratory, a materials-testing laboratory, and offices and classrooms. The electrical laboratory will be on the second floor. It will contain a constant-temperature gage laboratory. The third floor will provide 5000 sq ft of drafting-room space.

HYDRAULICS

A summer hydraulic laboratory to serve the engineering profession has recently been organized under the Laws of the State of Colorado under the name Rocky Mountain Hydraulic Laboratory. The site of the laboratory is on the North St. Vrain Creek, near Allenspark, Col., near the Rocky Mountain National Park. Several hotels and rental cabins are available within walking distance. The creek has a discharge many

FIG. 1 ARCHITECTS' DRAWING OF THE MAIN BUILDING, NAVAL ORDNANCE LABORATORY, WHITE OAK, MD

times that ordinarily used in hydraulic experiments and a fall of nearly 80 ft in the quarter-mile length within the 20-acre site.

Use of the laboratory's facilities will be open, upon registration and payment of fees, to all qualified persons. The laboratory will not grant academic credit or certify to attainments, but individual staff members are at liberty to do so on their own responsibility.

Trustees of the nonprofit corporation which owns the site and will operate the laboratory are Hardy Cross, Francis M. Dawson, Ivan E. Houk, Gerard H. Matthes, Adolph F. Meyer, C. J. Posey, John L. Savage, Edward Soucek, J. C. Stevens, Clifford H. Stone, Royce J. Tipton, and Sherwood M. Woodward. Mr. Matthes is president, Ralph W. Powell is secretary, and Mr. Posey will serve as director and treasurer.

According to the by-laws adopted by the trustees, "any member in good standing of the hydraulic sections or divisions of the American Society of Civil Engineers, The American Society of Mechanical Engineers, or the Society for the Promotion of Engineering Education shall, if he desires, be considered to be a member of the corporation, and entitled to all the privileges of membership, including right to attend meetings and that of joining with other members in making nominations for trustees."

COMPANY AIDS

The Hagan Corporation and its subsidiaries, Hall Laboratories and Calgon, Inc., have announced plans to assist members of their staff in getting college educations in night schools which will serve to upgrade them in their work with the three companies. The companies will pay half the tuition and fees for any course the individual enters, and on attainment of a degree, will pay the other half. Dr. Everett P. Partridge will supervise the plan.

NAVAL ORDNANCE LABORATORY

Preliminary work has begun in preparation for the construction of the main buildings of the Naval Ordnance Laboratory's new research center at White Oak, Md. The group of structures, to be built at a cost of $4,813,000, will include the administration building, the photographic laboratory, spherical field laboratory, long field laboratory, officers' quarters, marine barracks, and a portion of the roads which will connect the numerous units in the 938-acre area. A total of 50 permanent buildings are planned. More than a dozen of the smaller buildings have already been completed and a $300,000 boiler plant will be ready shortly. Cost of the entire project will be about $15,000,000.

Jet Engines

At a recent press conference George H. Woodward, manager, and R. P. Kroon, manager of engineering, Aviation Gas Turbine Division, Westinghouse Electric Corporation, South Philadelphia, described the jet engines developed by the corporation and displacing the 19B and the 9.5A types. The new plant in which the engines are built represents an investment of $10,000,000 and includes a $3,000,000 engineering laboratory devoted exclusively to the development of the gas turbine. Mr. Woodward said that on Feb. 1, 1945, when the Aviation Gas Turbine Division was established, it had 204 employees directly on its pay roll. At present, he added, the Division numbered 1100 employees and work was still being done outside the Division's own plant. In about one year he expected to have between 1500 and 2000 employees. The plant was designed for an annual capacity at maximum of $10,000,000 to $15,000,000 worth of aircraft engines. In addition to the jet engines, a sketch was shown of a propeller-drive gas turbine.

"The jet engine will be used exclusively when speed is important above all other considerations," Mr. Woodward said, "although jet-propelled planes are not yet very efficient from the standpoint of fuel consumption. This means that the jet engine will find its immediate application in high-speed interceptor planes which are not required to travel long distances from their own airports of aircraft carriers. The jet engine may also find application in extremely high-speed transport ships designed for relatively short-distance commutation,

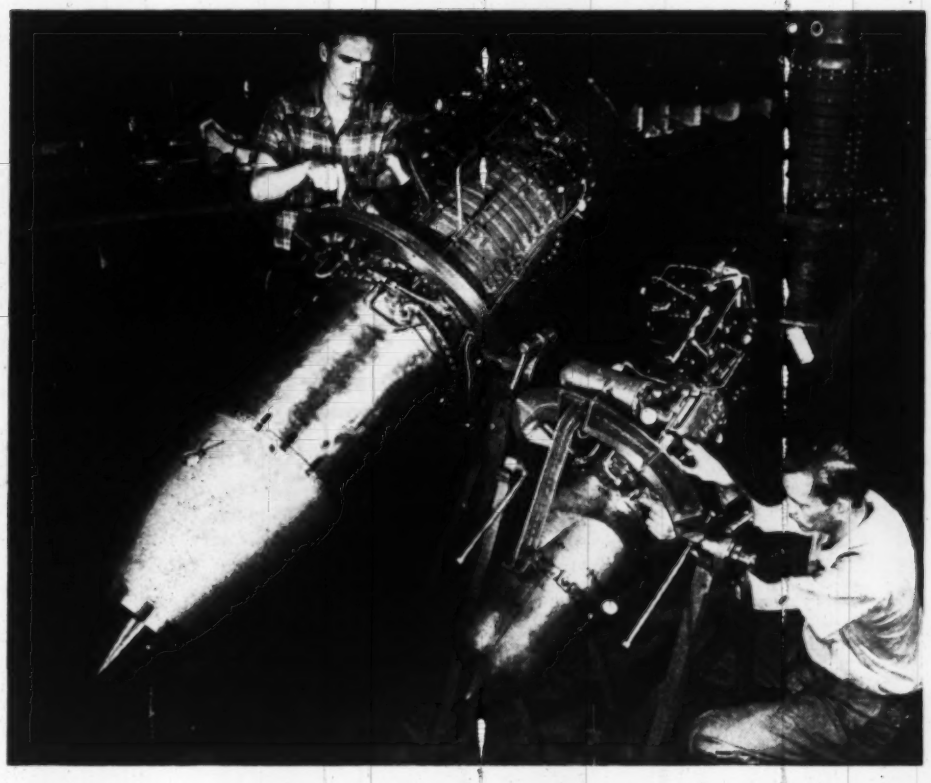


FIG. 2 THE WESTINGHOUSE 19B AND 9.5A JET ENGINES

as between New York, N. Y., and Washington, D. C. In such applications the poorer fuel economy of the jet engine may be economically overcome by the greater number of round trips that can be secured in a single day with one plane and one crew.

"The propeller-drive gas turbine will be used, perhaps more extensively than the jet engine, when high power combined with efficient operation is required in planes operating up to 550 miles per hour. For several years to come, the propeller-drive gas turbine will be favored in long-range heavy bombers and in long-range transport ships."

Mr. Kroon described the two engines on display. He said in part:

"The 19B engine is good for 1400 hp at modern plane speeds. A conventional aircraft power plant of the same horsepower has more than twice the diameter of this jet engine. To the best of our knowledge, we are making the smallest and lightest jet engine (for a given horsepower) in the world. This Westinghouse unit weighs only one half as much as the corresponding piston engine.

"Contrary to the rocket, which carries its own oxygen for combustion, the jet engine brings in its air from the outside.

(1) Air is pumped in by a compressor.

(2) The air is heated by burning liquid fuel in it.

(3) A portion of the energy of the hot combustion products, which have been expanded to several times their original volume, is used to drive a turbine, the sole purpose of which is to supply power to keep the compressor going.

(4) The remaining horsepower is not delivered to a shaft, but appears in the form of a high-velocity jet. It is reaction of this jet that propels the aircraft.

It is possible to take more power out of the turbine than is needed to drive the compressor, and this surplus power can then be used to drive a propeller. Such an arrangement, in which only a small part (20 per cent) of the energy remains in the jet, is known as a gas-turbine propeller drive.

Contrary to the present-day piston engine, the jet engine really has only one moving element. The compressor, the combustion chamber, and the turbine are arranged in line. This is one reason for the streamlined appearance of these jet engines.

Another reason for the small diameter is that we have selected the axial-flow type of compressor. Contrary to the centrifugal compressor, which utilizes centrifugal force to pump up the medium and requires large diameter, the axial-flow compressor is like a fan with many blades, that pushes the air backward toward the combustion chamber. In this six-stage compressor the rotating blades go around at a speed of 18,000 rpm, that is, 300 times a second. At 18,000 rpm the compressor delivers air at the rate of 50 tons per hour to the combustion chamber.

The combustion chamber is something like a perforated waste-paper basket, and the compressed air enters the burner baskets through these perforations. Fuel is sprayed in through a row of atomizing spray nozzles. A spark is used for ignition, but as soon as the flame has started, the ignition can be cut off because the combustion is continuous. The air particles spend

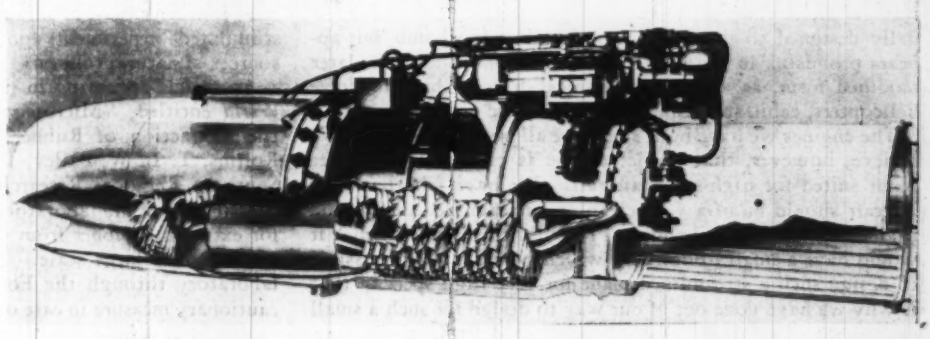


FIG. 3 CUT-AWAY DRAWING OF WESTINGHOUSE JET ENGINE

only $^1/_{100}$ of a second in the combustion chamber. The rate of combustion is so intensive that in a given space 1000 times as much heat is released as in a conventional power-plant boiler. Brought up to a temperature of 1500 F, the combustion products then enter the turbine where they give off a good deal of their energy to drive the compressor. The tips of the turbine blades move at 800 mph. They are revolving so fast that the centrifugal pull on each turbine blade is 50,000 times its own weight.

As the air enters the engine, it first cools the lubricating oil. The aluminum oil cooler is located where it is subjected to cooling air independent of whether the airplane is flying or on the ground.

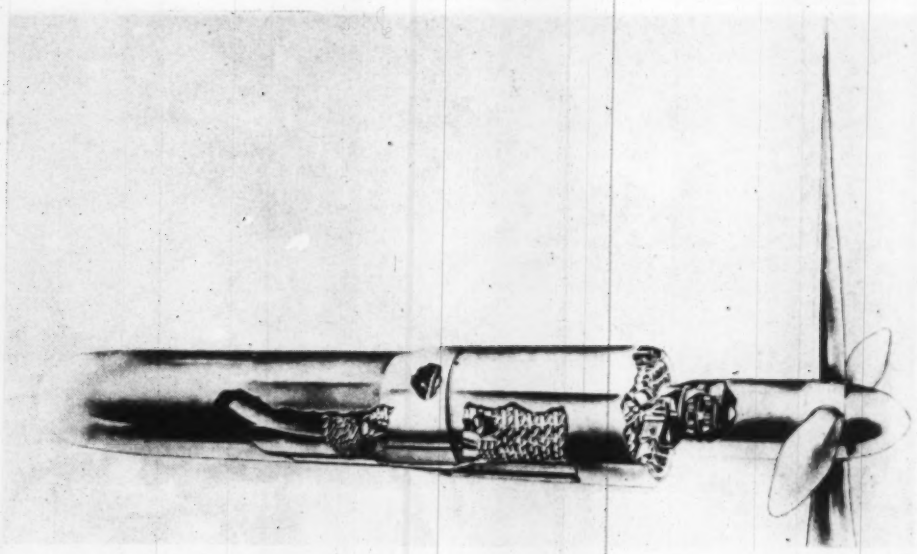


FIG. 4 WESTINGHOUSE GAS-TURBINE AIRCRAFT-PROPELLER DRIVE

After having gone through the turbine, the gases then enter the exhaust nozzle. From here the jet exhausts as a 1200-mph gale.

This exhaust nozzle is one in which the area and thereby the velocity of the jet can be varied by a movable tailpiece.

The accessory drive comprises those accessories which serve the engine proper and they consist of:

(1) An electric starter to bring the engine up to the speed at which it can maintain itself.
(2) Fuel pump to deliver fuel to the combustion chamber.
(3) Oil pump to circulate the oil to the bearings and to the coil cooler, which is mounted in front of the engine where air cooling is available at all times.
(4) An overspeed control to prevent the engine from "running away."
(5) An electric tachometer to give a visual indication of rpm to the pilot.

The accessories which serve the airplane are:

(1) A generator to provide electric current,
(2) A hydraulic pump to furnish high-pressure oil to serve wing flaps, landing gear, etc., or,
(3) A vacuum pump to operate the aircraft instruments.

The 9.5A engine has many of the same features. Its top speed is 34,000 rpm, 567 revolutions per second. It was originally designed to power an American buzzless bomb, but appears promising in general to drive small planes and, in later modified form, as a small mechanical-drive turbine to drive helicopters, cabin superchargers, and electric generators.

The engines we have built so far are all pure jet engines. We believe, however, that the jet engine is essentially a power plant suited for high-speed aircraft. We have felt that such aircraft should be of a very clean and streamlined design and that it was extremely important to build the engine so that it would have a small frontal area which would make it possible to design such a streamlined plane for very high speeds; that is why we have gone out of our way to design for such a small diameter.

Our analysis of gas-turbine propeller drives has proved that we can build a gas turbine of only one half the diameter of the reciprocating engine of the same power. We are confident that we can build a gas turbine with an installed weight between one half and three quarters of the installed weight of the piston engine.

Our studies show that on a large plane the gas turbine would give performance which would be superior to the piston engine in every respect, namely, in range of the aircraft, maximum speed, rate of climb, pay load, and take-off distance.

In addition, the inherent simplicity of the gas turbine, the fact that practically no cooling is needed, and that vibration problems and noise are much reduced as compared with the piston engine, will make the gas-turbine propeller drive extremely attractive for future aviation.

Already today there is a demand for engines of 6000 and 10,000 hp. The Germans built an 8000-hp jet engine. A piston engine for such powers would be a difficult piece of machinery to build, and it is doubtful if its size and complexity would not be prohibitive. But we see no reason at all why jet engines or gas turbines of 6000 or 10,000 hp cannot be built almost immediately.

Rubber Technology

OUR entry into war with Japan in 1941 created an extremely critical situation in regard to our rubber supply. This stimulated experiments on any and all possible domestic sources of natural rubber.

An article appearing in the September issue of *India Rubber World* entitled, "Microscopical Studies in Connection With the Extraction of Rubber From Goldenrod," by Mary L. Rollins, T. L. W. Bailey, Jr., and Ines V. deGruy, all of the Southern Regional Research Laboratory, New Orleans, La., describes how the laboratory went about developing a process for extracting rubber from the goldenrod leaf (*Solidago leavenworthii*) on a large scale. This work was carried out by the laboratory through the Emergency Rubber Project as a precautionary measure in case our small but vital supply of natural rubber from other countries should be cut off.

Extensive investigations by Thomas A. Edison in the last

years of his life resulted in the choice of goldenrod as a native source of rubber with commercial possibilities. While there were other rubber-containing plants, he saw in goldenrod a plant of great climatic tolerance that could be adapted to the annual crop system and harvested mechanically.

The Research Laboratory, during 1942–1944, made microscopical studies to demonstrate the presence of rubber in the goldenrod plant and to follow microscopically the effectiveness of various methods for its removal. By means of modified standard histological staining techniques and microscopical observations, it was possible to demonstrate the presence of rubber in the chlorophyllous cells of the goldenrod leaf and the relative nonoccurrence of rubber in all other parts of the plant. Extension of these techniques to control studies of laboratory and pilot-plant procedures has made it possible to follow microscopically the various steps in the development of a method for extracting the rubber.

Microscopical examinations of raw materials and processed residues have shown that the rubber in the leaf of the goldenrod plant is completely removed by an acetone-benzene extraction process if the raw material is finely ground before extraction.

Owing to the present improvement in the rubber situation the urgency of this project is now relaxed, but in the event of future emergencies, information is available on a commercial process for the extraction of rubber from goldenrod.

Machine-Tool Control

THE Bullard Company was host to a group of editors and technical writers on Oct. 11, 1945, when a demonstration of their Man-Au-Trol was held. The center for a ring gear was machined under full automatic control in approximately one fifth the time that would have been required for manual operation. The casting was mounted on the table of the vertical turret lathe and both the vertical and horizontal heads put through the required series of operations. The hub was rough- and finish-bored, the rim of the casting rough- and finish-turned for the gear ring, and both ends of the hub were faced. The necessary changes in speeds and feeds were made automatically in accordance with each particular operation in the series.

The heart of the Man-Au-Trol lies in a set of cams held in a housing at the end of ways on which each head moves. These cams serve to energize the various electric circuits through which the control operates. As many as 39 different operations can be controlled automatically.

Speeds and feeds are predetermined for each operation and the proper setting made. Any speed within the capacity of the machine may be used and sixteen feeds varying from 0.0007 in. to 0.125 in. in geometrical progression are available. The feed is set by means of a feed selector lever in each head.

Control of the operations is maintained through snap switches that are thrown by adjustable blocks. The movement of these blocks corresponds to the movement of the heads. The blocks themselves are suspended from and attached to wires on which they are positioned by setscrews.

Accurate positioning of the blocks relative to the switches is obtained by micrometer adjustment of the wires themselves. One end of the wire is attached to a heavy spring while the other end passes through a swivel nut held in the end of the frame. Adjustment of these nuts against the tension of the springs will vary the position of block with a high degree of accuracy. The switches and wires are contained in a box mounted on the machine.

To set up the control the workpiece is clamped to the table and the various operations carried out manually. The necessary adjustments are made for each cut as it is taken. If a finished piece is available it may be used as the master piece for positioning the tools and switch controls. Once set up the machine will go through as many repetitive operations as necessary with a high degree of accuracy. It is only necessary for the operator to start and stop the machine through push-button control, and to load and unload the table.

A change from manual to automatic control is made through a single lever. After the machine has been set up this lever is thrown to the automatic position for full-automatic control. At any time during a run this lever may be moved to the manual-control position in order to turn out a workpiece for which the machine is not set up. It is estimated that anything over a run of ten pieces will justify the extra time required for setting full-automatic control. Below this number manual control is recommended.

Peacetime Radar

H. C. LAURENCE, of Radio Corporation of America, in an article entitled, "War-Developed Radar Promises Swift Peacetime Progress," in the September issue of *Aviation*, tells of the many future uses of radar (derived from the words *ra*dio *d*etecting *a*nd *r*anging) and how it can increase aeronautical utility, comfort, and safety. Mr. Laurence not only discusses peacetime uses of radar, but also gives some interesting technical data on this heretofore highly secret subject.

Many of the technical data in the article, other than a description of the fundamental operation of a radar system as outlined by Mr. Laurence, are omitted from this review. Briefly, in operation a radar system sends out short pulses of radio energy in the direction to be explored. If the radio energy pulses strike a reflecting object, such as an airplane, some of the energy is reflected back toward the transmitting location, where the reflected energy is picked up by a receiver. The time required for the pulses of radio energy to travel from the transmitter to the reflecting object and back again to the transmitting location is then measured. With the speed of radio waves known, it is possible to convert the time of travel into the distance of the reflecting object. Modern radar equipment is calibrated directly in terms of distance. The direction of the reflecting object is determined from the direction in which the energy is sent out and received. The distance (and even direction) appears on the screen of a cathode-ray tube.

The article points out that during the war radar equipment was used to detect enemy aircraft and measure its distance, direction, speed, and altitude, both from ground stations or other aircraft; to warn airplanes of the approach of other aircraft or an obstruction; as absolute altimeters; and to control guns, searchlights, fighter planes, and bombers. Some of the war applications and equipment might be adaptable to civil aviation, while the military applications may never be employed by civilian aviation, such as gun directing, because of size, weight, and operating personnel required which would make application uneconomical.

Some of the postwar uses of this wartime equipment in aviation discussed by Mr. Laurence are its use as a navigation aid, blind landing, collision prevention, and airport traffic control.

Seen as a navigation aid, a long-range navigation system, termed loran (derived from the words *lo*ng *ra*nge *n*avigation) is useful on ocean routes, and long routes over uninhabited territory where it is impractical to establish long-range systems. This is already well-established on the world-wide air-transport routes of both Army and Navy. Loran equipment, not

being unduly large nor heavy, will undoubtedly be used on commercial air-line routes in the future. However, details and operation of equipment are still being withheld for security reasons.

As for use in blind-landing systems, some present ground and air-borne radar systems can be applied to blind landing, but there are simpler nonradar systems that place the heaviest equipment and maintenance burden on the ground instead of in the plane. Versions of present blind-landing systems providing runway-localizer and glide-path beams will continue in use for some time.

Collision prevention is one of the most often suggested civil radar applications. "To be useful as a collision-prevention device," writes Mr. Laurence, "a radar system must not only detect the presence of an airplane and determine its distance, but it must also determine the altitude of the detected airplane with respect to the airplane carrying the detector, and determine the direction in which the detected airplane is traveling. Furthermore, the equipment should automatically warn the pilot of impending danger and not require continuous attention of an operator in the airplane. All of these requirements must be met by a system requiring only lightweight air-borne equipment. However, the difficulties of obtaining a lightweight, completely air-borne unit providing a dependable, easily read danger indication to a busy pilot are at present so great that many engineers have concluded that collision prevention can best be handled from the ground."

The use of radar to control airport traffic will greatly increase the capacity of large airports by simplifying and speeding up traffic control. The pilot of an airplane approaching a radar-controlled airport, can push an identification button on his instrument panel and cause a coded signal to appear near the indication that represents his plane on the control-tower indicator, each air line or type of service having its own code. The airport control operator can then call the approaching plane when he is ready for it and give any special landing information needed. A simplified version of present military equipment carried by the aircraft should not weigh over 20 lb. If found practical, auxiliary radar equipment can determine each plane's altitude directly from the control tower.

Silicones

OUT of research in the field of polymeric chemistry has come a new family of fluids, gels, plastics, and solids, legion in number and variety and spectacular in the revelation of their unusual properties. This family is called "the silicones" and its unexplored ramifications promise a catalog of silicone derivatives as extensive as the hydrocarbon derivatives of organic chemistry.

The silicones are not purely organic, nor are they purely inorganic. They hold the unique position of standing between these two great classifications of the nature of chemical compounds, and their properties reflect this position by revealing a kind of an amalgamation of the properties of some of the hydrocarbons with those of inorganic ceramic materials.

Because silicon lies in the same group and next to carbon in the periodic tables, and because both elements have the same valence of four as well as many chemical similarities, chemists have always felt that the molecular structure of an organic compound could be changed into that of a semiorganic compound by substituting the silicon atom for the basic carbon atom.

This was first done in 1904 by Dr. F. S. Kippling, professor of chemistry, University of Nottingham, England, when he discovered that certain organo-metallic compounds would react with silicon tetrachloride to form organo-silicon polymers. From this beginning a large number of organo-silicon-oxygen compounds were developed. This development, however, served no practical purpose. About ten years ago, the chemists of the Corning Glass Works, in the search for a glasslike plastic, picked up the threads of Dr. Kippling's work and brought forth the amazing silicones.

The dress-up name for the silicones is "polyorganosilozanes," and when a chemist speaks of the physical differences in the silicone family, he attributes these differences to differences in degrees in polymerization. While such terminology may be only so much confusing polysyllabification to the mechanical engineer, the meaning can be translated by the grace of Mr. Webster, to more comprehensible monosyllables.

"To polymerize," says Webster, "is to change (by union of two or more molecules of the same kind) into another compound having the same elements in the same proportions, but higher molecular weights and different physical properties."

The silicones polymerize in two general formations: In linear or chain formations and in cross-linkages, that is, one chain above the other. Long-chain silicon molecules without cross-links form clear, water-white fluids. The longer the molecular chain, the more viscous is the fluid. Properties such as solubility and fusiblity are determined by the extent of the cross-linkage with organic molecules, while the mechanical and chemical characteristics of the compound are determined by the kind of organic molecules used in the cross-linkage. The higher the degree of polymerization the more dense is the physical nature of silicone. Silicones polymerize without inducement and the chief difficulty appears to be to restrain the polymerization and to direct it along the desired channels.

While the basic materials out of which silicones are made, i.e., the sand, brine, coal, and oil, are generally abundant, the process of synthesis requires a considerable amount of industrial and chemical technology. The Dow Corning Corporation, Midland, Mich., was the first and still is the only plant in commercial production of silicones. Here in a plant composed of stills, pressure tanks, cookers, and piping, arranged in a manner typical of an oil refinery, the complex chemical processes are performed.

The family of silicone polymers includes materials that are far apart in physical properties. In general, there are four groups which can be classified as follows:

(1) *Varnishes and Resins.* These silicones have been used to insulate electric motors and generators because of their outstanding ability to withstand heat and to resist moisture. The dielectric properties permit greater freedom from overload failure and from fire hazard.

If the silicone insulation should break down in such an application, silica formations possessing good insulating properties would be formed instead of carbon formations which are the inevitable results of breakdown of organic resins, and which are excellent conductors.

(2) *Silicone rubbers.* This group of rubbery silicones possess the exceptional characteristics of great resistance to heat, and retention of flexibility at temperatures as low as —70 F. They have also been used to coat glass fabrics which are used for high-temperature gaskets and diaphragm applications.

(3) *Greases and Compounds.* Silicone greaselike substances of petroleum-jellylike composition have been found to change very little in consistency over the temperature range of —40 to 400 F.

(4) *Silicone Fluids.* Liquid silicone polymers have been obtained in a wide viscosity range. They include volatile as well as nonvolatile oils. They are heat-stable, inert, have

good electrical properties, and are insoluble in water. To the mechanical engineer these fluids are of particular interest because of their potential use as lubricants.

SILICONE LUBRICANTS—SILICONE GREASES

Considerable work has already been done in the direction of investigating the utility of silicone fluids as substitutes for petroleum lubricants. During the recent National Fuels and Lubricants Meeting of the Society of Automotive Engineers, T. A. Kauppi and W. W. Pederson, Dow Corning Corporation, presented a paper on "Silicones as Lubricants."

Speaking of the silicone fluids, the authors said that such properties as "low viscosity-temperature slope, nonvolatility, and low freezing point were all very desirable in a lubricant."

"When these properties are combined with the heat stability, oxidation resistance, and general chemical inertness characteristic of silicones," they continued, "the obvious conclusion seems to be that silicone fluids would make almost perfect lubricants for any sort of application. However, the one property of silicone fluids which has not yet been mentioned is that of lubrication; the foregoing conclusion as to utility is valid only if the silicone fluid reduces friction and prevents wear between the moving surfaces involved.

"One of the first experiments carried out on the lubricating properties of silicone fluids involved pumping the fluid with a small gear pump at various outlet pressures. The pump was operated at approximately normal rated speed. An initial test on an S.A.E. 10 motor oil showed that no appreciable wear occurred during 10 days of operation at outlet pressures ranging up to 100 psi. A run made with DC 200 silicone fluid of comparable viscosity produced extreme wear, as shown by suspended particles of steel in the fluid within one hour of operation at 25 psi outlet pressure.

"It was apparent from the foregoing and from similar experiences in other types of equipment that the DC 200 fluids did not have the lubricating properties of an ordinary petroleum oil."

The authors point out, however, that on some of the newer silicone fluids, particularly silicone fluid DC 710, wear tests show "less wear up to 2000 grams load than S.A.E. 10 petroleum oil, but about twice as much wear at 3000 grams load." The wear tests further reveal that "at 1500 grams load, DC 710 produces considerably less wear than the petroleum oil at all running times up to 16 hours. The tentative conclusions to be drawn from these results is that DC 710 is better than petroleum oil for steel-to-brass lubrication at moderate loads, but is less effective at loads approaching the extreme-pressure range."

Other tests showed that the lubricating properties of silicone fluids depended on the kind of metal-wearing surfaces in use. For example, with hardened steel on hardened spring steel, the silicones DC 200, DC 550, and DC 710 compared favorably with S.A.E. 20; in the case of hardened steel on soft steel, DC 200 and DC 550 were poor as lubricants, while DC 710 was as good if not superior to S.A.E. 20.

"Many grease problems are caused by the tendency of the oils used in greases to evaporate or oxidize, resulting in eventual hardening or caking of the grease. Since silicone fluids are definitely superior in volatility characteristics and oxidation resistance, work was started about two years ago to develop a silicone grease for ball bearings," the authors said.

In one of the tests, silicone grease DC 41 was used in ball-bearings operating under a load of 150 lb, at a speed of 1750 rpm, and the grease was still good after 2600 hours of operation at 257 F. In another test this same grease survived 900 hours of service at a temperature of 347 F. From the accumulated data on silicone fluids and greases the authors draw the following conclusions with regard to silicones as lubricants:

(1) Silicone fluids offer possible solutions to lubrication problems involving heat stability, oxidation resistance, nonvolatility, and low viscosity change with temperature change.

(2) Different types of silicone fluids vary in their lubricating ability and in their behavior toward various rubbing metal surfaces. Some of the silicone fluids approach petroleum oils in ability to reduce wear.

(3) Silicone greases, because of their oxidation resistance and low volatility, should find application in the operation of ball bearings under severe conditions and in permanent-lubricated ball bearings where long service life is essential.

Information on the silicones was obtained from the following sources: (1) "The Organo-Silicon Polymers," by Eugene G. Rochow, General Electric Company; (2) "Silicones—A New Class of High Polymers," by R. W. Kolderman, *Canadian Chemistry and Process Industries*, March, 1945; (3) "The Silicones—A New Plastics Family," *Plastics*, January, 1945; (4) "Silicones—Miracle of Molecule Engineering," *Westinghouse Engineer*, September, 1945; and (5) "Silicones as Lubricants," by T. A. Kauppi and W. W. Pederson, Dow Corning Corp.

Versatile Vehicle

THE peacetime potentialities of the "water buffalos," the Army's amphibious tanks and tractors of remarkable work capacity, have been so universally recognized by industrial engineers in this country and abroad that the manufacturers of this work horse of war have received hundreds of requests for

FIG. 5 THE WATER BUFFALO

peacetime vehicles in a bewildering range of sizes, weights, carrying capacities, and accessories. In order to solve the problem of variety in the most economical manner, the manufacturers are seeking to standardize on not more than two peacetime commercial models.

The fighting water buffalos first won their renown by surmounting the coral reefs at Tarawa. Since that time they have been in every invasion, performing all kinds of duties. They have served as assault weapons, as cargo and personnel carriers, as hospital vehicles, and have even acted as ferries in the crossing of rivers and swamp land.

Interest in this versatile vehicle is particularly strong in South America where its use in the mahogany logging industry and in the ship-to-shore movement of cargo in the many harbors where docking facilities are not available, will give an outstanding economic advantage.

"The peacetime 'buffalo' could revolutionize the logging industry in South America," wrote one firm, "making it possible for a year-round operation instead of just three months."

Another large group of prospective purchasers want the vehicle for purposes of carrying ore over rough terrain and they want it in a size capable of carrying at least 20 tons of ore. In the cranberry industry the interest is in a light vehicle to operate in swampy fields.

The Food Machinery Corporation, creators of the vehicle, are considering a new peacetime "water buffalo" of the following characteristics.

Maximum length, 25 ft, 10 in.; maximum height, 8 ft, 1 in.; maximum width, 10 ft, 8 in.; draft, loaded, 54 in.; weight, unloaded, 24,700 lb; cargo capacity, 12,000 lb; width cargo space, 7 ft; cargo area, 88 sq ft; cargo volume, 541 cu ft; maximum grade-ascending ability, unloaded, 32 deg, 70 per cent; loaded, 24 deg, 54 per cent; maximum grade descending ability, 70 per cent; turning circle on land, 20 ft diameter, on water 50 ft diameter; power plant, 250 hp, gasoline; fuel, 80-octane rating gasoline, tank capacity 140 gal; consumption, approximately 8 to 10 gal per hr on land, and 10 to 12 gal on water at normal speed; speed (fully loaded), 22 mph on land and $5^1/_2$ mph on the water.

Plywood Airplanes

WOOD, one of the most ancient of engineering materials, achieved the distinction of playing the principal part in the construction of the world's largest airplane, a tremendous structure of 200 tons weight, a hull length of 200 feet, and a wing span of 320 ft, built by the Hughes Aircraft Company, Culver City, Calif. This airplane, the Hughes H-4, is so big that a sixty-ton tank can be loaded into the ship directly through the front cargo door, and a complete airplane as large as the B-19 Fortress can be carried in the space of its hold.

The Resinous Reporter has the following to say:

"Aside from its spectacular size, the most unusual feature of the Hughes H-4 is its virtual all-wood construction. Plywood is used throughout the plane for the frame of the hull, wings, tail surfaces, ribs, and for the covering of all major assemblies. Although aircraft manufacturers possessed considerable experience in the use of wood for small aircraft, the fabrication of the enormous component constructions for the Hughes H-4 presented many new problems. Solid wood could not be used, since trees do not grow to suitable size, and normal wood has too many inherent defects, especially in larger sizes. Successful fabrication of giant structures was achieved by laminating and cross-plying selected wood veneers with synthetic resin adhesives.

"Adequate strength and stiffness in laminated-wood products depends wholly on the effectiveness of the adhesive used between the veneers. Unless the adhesive is stronger and more durable than the wood, laminated structures could not be used in an enormous flying boat such as the Hughes H-4. The complete water resistance and successful record of synthetic resin adhesives in such severe applications as small aircraft and landing crafts, recommended their use in large constructions.

"For the production of the curved section of the Hughes H-4 the bag molding process was used. This involves the use of a mold over which layers of adhesive-coated veneers are laid cross-grained to give maximum stiffness and strength. After the assembly has been prepared it is enclosed in a rubber bag from which the air is exhausted by vacuum. Then the section is placed in an autoclave where steam furnishes both heat and pressure to fuse the veneers into a solid structure.

"The molding process requires a resinous glue which combines a delicate balance of properties. After spreading, the veneers (varying from $^3/_{32}$ to $^1/_2$ in. in thickness) are allowed to dry and then are stacked for periods ranging from several hours to days. This demands a resin which after spreading has a long permissible assembly period to allow for the careful fitting of individual plies. During bonding it is important that the resin neither flow excessively into the wood nor 'precure' before the proper curing temperature is attained. However, once the cure temperature is reached the resin should cure rapidly."

Human Engineering

THE forces that motivate the trend toward unionism have been under study during the past several years by the Division of Labor studies of the Yale Institute of Human Relations.

During a number of organizing campaigns extensive interviews were conducted in order to determine why some workers chose to join a union and others refused union membership.

The analysis of these studies, reported by E. Wright Bakke, director, Labor-Management Center, Yale University, in an article "Why Workers Join Unions" (*Personnel*, July, 1945), resulted in the following hypothesis:

"The worker reacts favorably to union membership in proportion to the strength of his belief that this step will reduce his frustrations and anxieties and will further his opportunities relevant to the achievement of his standards of successful living. He reacts unfavorably in proportion to the strength of his belief that this step will increase the frustrations and anxieties, and will reduce his opportunities relevant to the achievement of such standards."

In this hypothesis the concept of "standards of successful living" is crucial. There was almost universal recognition among the workers that one "is living successfully if he is making progress toward the experience and assurance of: (*a*) The society and respect of other people; (*b*) the degree of creature comfort and economic security possessed by the most favored of his customary associates; (*c*) independence in and control over his own affairs; (*d*) understanding of the forces and factors at work in his field; and (*e*) integrity."

It is felt by Mr. Bakke that these are universal goals to which all people are striving and that they do not differ in type from those motivating the different groups in society.

"To classify unionism, therefore, as a mechanism for collective bargaining for economic advantage," Mr. Bakke concludes, "is to underrate its importance in a democracy. The contribution of unionism at its best is its provision of a pattern of life which offers chances of successful adjustment and goal realiza-

tion, not for the few who get out of the working class but for the great majority who must stay there. It provides them with a realistic medium through which their common interests may be expressed and their common needs met. It gathers together the threads of individual lives, made of the same stuff but tangled, straightens them out, and weaves them into a patterned fabric which is not only of importance in itself but which gives new importance to each thread."

The profession of engineering calls for the handling of materials other than those that go into the fabrication of structures and machinery. Often the handling of human material decides the quality and efficiency of an engineering enterprise. The leadership of people, therefore, is an art that bears cultivation.

One of the small crises of management occurs when an employee is so disturbed about his immediate conditions that he addresses his troubles and dissatisfactions to his superior.

A method of handling such a situation is suggested by Schuyler Dean Hoslett of the Kansas City Quartermaster Depot and Park College, in an article, "Listening to the Troubled or Dissatisfied Employee," (*Personnel*, July, 1945). He says that it is essential to get down to the causes of the dissatisfaction. "The employee should be allowed ample opportunity to talk after he has been put at ease in the beginning of the interview. In itself, the opportunity to talk out his problem is of considerable therapeutic value. By putting his thoughts into words he is compelled to think his problem through more completely; often, by the end of the discussion he will have arrived, apparently unaided at the obvious and desired solution."

To a dissatisfied employee it is fatal to give advice, ask leading questions, or to express opinions, until the employee has expressed the causes of his dissatisfaction at his leisure, without emotional stress, and in his own way.

Mr. Hoslett feels that the "nondirective" technique, one in which the listener does not direct the conversation along preconceived channels but permits the employee to reveal in his own way the nature of his dissatisfaction, is the most useful method for restoring harmonious employee relations.

Electric Power in Germany

THE War Production Board, through the Technical Industrial Intelligence Committee, Washington 25, D. C., has made available a "Summary Report on Investigation of Electric Power Practice in Germany," by Herbert J. Scholz and Charles F. Wagner; and "Interview with Dr. Krone," by H. J. Scholz. Included is a paper entitled "Technic of Berlin Electric Supply by BEWAG," prepared by Dr. Ing. Erich Krone. Dr. Krone was formerly the head of the Electrical Research Department of Berliner Kraft und Licht A. G. (BEWAG). These reports result from investigations instituted in Germany by the War Utilities Subcommittee of the Technical Industrial Intelligence Committee.

The investigation of the electrical features of the German power systems was carried out to uncover what might be new in German technique and practice through personal inspection of plants and interviews with informed German engineers.

The Committee found that the Germans made little or no advances in the art over that which had been known as of 1939, since all development not directly concerned with the war effort had been held in abeyance. Only a few engineers could be interviewed by the committee due to unsettled conditions and the inability to visit important power plants and targets located out of the American zone. Although some interesting information was obtained it is possible that some of the developments in progress may not have been uncovered at this time.

While new developments were found to be of a minor nature, there are some practices that differ from those in other countries. These, together with new developments discovered, are fully discussed in the "Summary Report." The outstanding differences and developments covered are (1) the general use of the Peterson coil on 110- and 220-kv circuits; (2) the almost universal use of the air and low-oil instead of the conventional-oil circuit breaker; (3) the projection and design of a 400-kv alternating-current transmission system with its associated apparatus; and (4) the projection and design of a 400-kv direct-current transmission line to be operated on an experimental basis over underground cables for a distance of about 160 km (100 miles).

In interviewing Dr. Krone it was found that he was well informed on power conditions in Berlin and on German electric practice in general. When asked about the general power system for Berlin, Dr. Krone stated he had just completed a paper (Technic of Berlin Electric Supply by BEWAG), on the subject for the Military Government, American Zone, Berlin, and submitted a copy which is included in the report. The paper, among other items, describes the power-generating facilities, transmission, and distribution system, and dispatching and research work carried on by BEWAG.

Atomic Energy

FOR the benefit of practical engineers everywhere, R. E. Fearon, physicist, consultant for Wells, Incorporated, in his article, "Oil Uses for the Atom," in the Sept. 10 issue of *Oil Weekly*, has given clarity to the subject of atomic energy by his simple analogies and his comparative tabulations which review in an understandable manner what happens during atom splitting and what possibly may be done with the important products of this reaction.

"When T.N.T. explodes," he says, "the energy is evolved because the atoms present in the original T.N.T. molecule rearrange themselves in new and stabler ways, making up new molecules with less available energy. The T.N.T. bomb is, therefore, an "atomic bomb," because its energy is derived by rearranging atoms into new combinations. The atomic bomb of recent history is, however, really a nuclear bomb, since its energy is not derived by rearranging whole atoms in new ways but rather by rearranging the matter of the inmost part of the atom, the nucleus, into new forms, creating new nuclei and new and different atoms thereby.

"In the explosion of the fission or atomic bomb, as in the explosion of individual atoms in a radioactive substance, there is a real transmutation of elements. Practically every known spontaneous transmutation of elements produces immensely more energy per unit weight of material involved than is derived when atoms are rearranged into new molecules."

Mr. Fearon shows that when carbon and oxygen combine to form CO_2 as in the combustion of carbon, only 4.15 kwhr of energy are generated per pound of fuel employed, but when one pound of U 235 breaks down into barium and krypton 9 million kwhr of energy are released.

In explaining that the atomic-bomb reaction was the same kind of reaction as that which occurs in ordinary radioactive processes, Mr. Fearon says that in radioactive materials such as radium "the nuclei of the atoms split, but the fragments are so unequal that it is as if a little chip was knocked off a sphere of nuclear matter. In the fission of the uranium 235, however, the nucleus of the uranium atom practically breaks in two in the middle. The energy produced when a

uranium atom undergoes fission is tremendously greater than the energy produced when little chips are knocked off "an atom of radium."

A question of major significance with regard to atom splitting is whether this reaction can be controlled so as to allow practical use of the tremendous amounts of energy available.

"It is my opinion, as a nuclear physicist, that this can be readily done," states Mr. Fearon. "In fact, I feel sure the problem is already solved."

Among the products of nuclear fission or atom splitting, Mr. Fearon lists the following:

1 Energy which can be used to generate steam or produce chemical reactions.
2 Gamma rays (like X rays).
3 Beta rays (rapidly moving electrons).
4 A strong stream of neutrons (moving neutral particles having approximately the mass of a hydrogen atom but squeezed into enormously less space.
5 New substances, made up of the larger fragments of the uranium 235 nucleus.

Not so much as a source of power but more as a harbinger of new tools and methods of research does Mr. Fearon see in nuclear fission the promise of good living.

Should it be desirable to follow certain groups of atoms through various chemical reactions, this can now be done by radioactivating that particular group of atoms by means of nuclear fission. These radioactive atoms can easily be traced by a detector of gamma rays. More important perhaps will be the radioactive substances of a hundred kinds, with radioactive properties adopted to every use which will be abundantly and cheaply made available by fission of uranium 235.

Because of the abundant source of gamma rays produced by atomic fission, radiographic and fluoroscopic investigations formerly prohibitive because of cost and inconvenience will now be available to industry.

On the fringe of present knowledge, there are such applications of the products of nuclear fission as the production or acceleration of chemical reactions by nuclear radiation which can be used much as heat is commonly used. Already some gaseous hydrocarbons have been transformed into liquid and solid ones by means of radiation derived from atom splitting. Methene, ethylene, and acetylene have already been transformed.

With regard to the new power and its effect on the petroleum industry Mr. Fearon says that the net result "will not necessarily be an injury (to the industry), however, since atom-splitting energy may sufficiently stimulate industries consuming petroleum to offset the losses. A general enlargement of industry, brought about by the new prime mover, would require more lubricants, more organic synthetics, and more rubber and rubberlike products, many of which could be derived from petroleum.

Uranium Ores

SOME interesting information and data about uranium, principal source of obtaining useful atomic power, is presented by Dr. E. U. Condon in the November issue of the *Westinghouse Engineer*. The article reads as follows:

"Although uranium is contained in over one hundred minerals, only two—pitchblende and carnotite—are of great importance. It is estimated that uranium is present in the earth's crust in the proportion of about four parts per million. Early rough estimates were that the nuclear energy available in known world deposits of uranium is adequate to supply the total power needs of this country for 200 years (assuming utilization of U^{238} as well as U^{235}).

"Pitchblende is found in metalliferous veins, notably Bohemia and Saxony. More recently deposits have been found in the Belgian Congo and the Great Bear Lake region of northern Canada. Most of the importations to this country during 1942 and 1943, the last years for which importation figures are available, were from Canada and the Belgian Congo.

"Pitchblende of good quality contains as much as 80 per cent of uranoso-uranic oxide (U_3O_8). It is a brown to black ore with pitch-like luster in the form of crystallized uraninite. Madame Curie was among the first to recognize this material as a source of radium.

"Carnotite, the second main source of uranium, has been discovered in Arizona, Colorado, and Utah. It is found as a canary-yellow impregnation in sandstone. Production of this ore climbed steadily during the middle thirties from a low of 254 short tons in 1934 to the high of 6256 in 1939. The actual pounds of uranium extracted from the ore produced in 1939 were 59,269. The actual extent of deposits has not been divulged.

"Until recently, the only use for uranium was as a coloring agent for ceramics and glass. It was used in amber signal lenses and in glass of special coefficient of expansion for glass-to-metal contacts in radio tubes."

Science for World Service

THE aptitude of the engineer for the responsibilities of world statesmanship was quietly demonstrated before the New York Herald Tribune Forum held in November at the Waldorf-Astoria Hotel, New York, N. Y., when Dr. Vannevar Bush, engineer, teacher, inventor, director of the Office of Scientific Research and Development, and president of Carnegie Institute, Washington, D. C., as spokesman for science, addressed the session on "Science for World Service."

Stating simply that the present generation, confronted by a most fateful decision, holds in one hand "ruin and suicide" and in the other "friendship and abundant life," he went on to enumerate the significant import of the atomic bomb. He said:

"First, we can never be thankful enough that the secret was learned by the peace-loving peoples, not by the Fascist nations which sought with all their might to master it in order to unleash atomic war on the whole world.

"Second, the bomb did not win the war; the bomb did end the war swiftly and, I think, mercifully, and thereby saved many thousands of human lives.

"Third, and this is extremely important, by reason of its sudden spectacular effectiveness, the atomic bomb underscored and emphasized as never before the fact that the nations of the earth must put an end to all wars forever.

"Fourth, and of equal import, the development of the bomb, the work of a congress of free minds and free hands in a free country, is undying testimony to the strength and vitality of the philosophy of government in which we believe. Only in a free country where people have faith in the good will of one another could so vast an undertaking have been carried through so successfully in so short a time."

That the complexity and difficulty of this achievement served to re-emphasize forcefully how effective could be the teamwork of science, management, labor, the military, and government was stressed by Dr. Bush.

"The science of atomic energy today," he continued, "is comparable to the science of electricity in the time of Faraday. Things move faster today than they did a century ago, hence we

may expect that though it is far more difficult, the development of atomic energy for peaceful industrial and economic use will be swifter than was the development of electricity. The atom should be at useful constructive work for us within ten years. Yet it will not perceptibly alter the pattern of our living until long after that. We shall still use steam and electricity for lighting and power. The atom will generate these things—not drive the family car."

Speaking against the background of scientific knowledge and the habits of the engineering mind, he said, "As an engineer, I have good reason to know that free exchange of ideas and knowledge is the first requirement of progress. We had such a system before the war, and under it American science led the world. It must be restored, for only by the cross-fertilization of brains do we breed great thinking. Therefore, I hope to see the United States make the first great move toward the renewal of international exchange of scientific knowledge. I believe we should undertake to share with our world partners all of our basic scientific knowledge of atomic energy."

"The secret of the atomic bomb," Dr. Bush revealed, "resides, as much as it exists, primarily in industrial experience, the solving of a multitude of practical problems, and the intricate techniques of application. It cannot be too strongly emphasized that no man could convey this information by a formula or a diagram or two if he would; it is much too complex for that."

He said that the road to full trusteeship of the atomic weapon for all military embodiments and the provisions for its use only under the orders of a world authority was a long and slow one.

"The first step toward that ultimate goal," Dr. Bush explained, "is to establish the full free flow of facts—the complete and honest exchange of knowledge—among the nations. We Americans are the first to be in full possession of the most powerful and most precious knowledge of the physical world ever discovered. We can, therefore, open the way toward assuring the growth of the full free flow of facts by providing for complete interchange of information on the basic scientific aspects of atomic energy. In the War Department release in early August we made the right start, and I believe we should go farther on that course. The strongest help that we can give to bettering the common destiny of mankind is to demonstrate in this way our faith in the good will of men and our desire to be one nation among other nations in a peaceful world of free interchange."

Indium

THE activity of the war years has seen the coming of age of indium, once an extremely rare metal and a laboratory curiosity, but now the latest element to have achieved recognition of its highly important and commercially adaptable qualities.

Wm. S. Murray, president, The Indium Corporation of America, in a talk given before the Philadelphia chapter of the American Chemical Society, and published in the July, 1945, issue of *Modern Metals*, says, "Indium has been called 'the miracle metal' and rightly so, because while indium is in itself a soft metal, the use of only a small amount will bring to nonferrous metals greater tensile strength, increased hardness, as well as resistance to wear, friction, abrasion, and corrosion."

In physical appearance indium is a silver-white crystalline metal which is softer than lead, malleable, and ductile. It is stable in dry air at room temperature, but upon heating it will burn with a blue flame to give indium trioxide. In some ways it is like zinc and in others like aluminum and iron.

Indium was discovered by Reich and Richter, two German scientists, in 1863, but until the early 1920's when Dr. Murray obtained a gram of this rare metal and discovered its value in stabilizing nonferrous metals, little interest had been shown in this extremely rare element. While there are, as yet, no indium mines in the world, indium has been found in some zinc ores and in the past few years in sufficient other ones to assure a constant supply to meet the steadily increasing demand.

Because of its ability to give to nonferrous alloys increased strength, hardness, and resistance to wear, indium was of great interest to the dental profession where it was first used in dental alloys.

As a decorative metal indium has been used in silverware, where small percentages of it result in a material hardening and where its silver-white color does not affect perceptibily the beauty of the silver.

When alloyed with copper, attractive finishes are produced which can be highly polished and which are not susceptible to oxidation or sulphidation.

In the field of brazing alloys where there are several solders of relatively low melting points (up to 600 or 700 F) but few in the difficult gap between 700 and 1100 F, indium, because of its low melting point, 311 F, and its readiness to alloy with copper, silver, and other elements, is filling a great need by making possible brazing alloys of good strength and flowability whose melting point is in the range from 795 to 965 F.

In the war aviation industry, aviation bearings treated with indium stood up so well under the extreme conditions imposed on aviation engines that they have been established as standard for aviation bearings.

Dr. Murray has this to say of the silver-lead-indium aviation bearing:

"Each of the three components of this splendid bearing has a service to perform. Silver has the internal properties which resist failure due to fatigue. Externally, silver lacks the qualities of oiliness needed in a good bearing surface. To fill that requirement, a thin layer of lead is applied to the silver surface. Unfortunately, lead is soluble in the organic acids present or formed in lubricating oils. To offset this difficulty a thin layer of indium is deposited on and diffused into the layer of lead. This addition of indium to the bearing surface accomplishes:

"1 Indium increases the strength of the bearing material into which it is impregnated.

2 Indium prevents corrosion of the bearing surface without impairing the fatigue resistance or the bearing properties.

3 Indium permits the bearing surface to retain its oil film more completely, by increasing its wettability."

The latest successful application of indium-alloy coatings has been on brass in an installation where protection for metallic surfaces was required against extreme climatic corrosion. After one year the indium-alloy coating has shown no evidence of corrosion products found on some of the other materials tried.

The operation of applying indium-alloy coating on a base metal is likened to the operation of buttering a piece of bread and placing it into the oven so that the butter may melt and permeate into the bread. Actually, indium is electroplated on a clean nonferrous surface. The full values of indium require, however, that the indium become diffused into or amalgamated with the base metal. To accomplish this, the plated part is placed in an oven or a hot-oil bath and given about two hours of heat-treatment at a temperature of 350 F which is slightly above the melting point of indium.

The future of indium appears bright. At the present cost of $3.66 per troy ounce for metal of 99.9 + purity, it is competitive with other finishes when all factors in the production of plated surfaces are considered. New sources of supply and new methods of purification will tend to reduce cost.

To A.S.M.E. Members:

THE COUNCIL REPORTS FOR 1945

High Lights

1. **Active war research support.**
2. **Spectacular progress in international standardization.**
3. **Meetings hampered by transportation restrictions.**
4. **Publications hampered by paper shortage.**
5. **Steady progress in Divisions and Sections.**
6. **First official lectures.**
7. **Student Branches, at low ebb, will require active support.**
8. **Technical committees report good work despite war.**
9. **Vice-Presidents given regional responsibility.**
10. **Finances in excellent condition.**
11. **Development Fund for technical work established.**
12. **Membership nearing 20,000.**
13. **Pension Plan established for Secretary's Office.**

THE ending of the war during this Society year created problems of demobilization of the armed forces and of wartime industry, and reconversion to peacetime production, the solution of which can be greatly facilitated by the engineering profession.

This war was won by fighting men, but they were supported by engineers in the armed forces and on the production front. The industrial and engineering accomplishment of supplying and maintaining the complex needs of modern war to the greatest armed force in history, deployed to the remote parts of the globe, is an achievement without parallel.

Mechanical engineers did their part; 3000 of our members were in uniform, and the rest, in production, in training, and in research, were all out for the support of the armed forces.

Two world wars are enough! Engineers know that, in addition to aggressive organization for peace, there must be a continuously perfected technique of the applied sciences for war. As citizens they will make their influence felt.

THE SOCIETY AND THE WAR

Three agencies of the Society and several of the joint agencies with which the Society is connected have been making a direct contribution to the war effort. A comprehensive program of research on forging and machining of shells and bombs is being carried on by the A.S.M.E. Research Committee. The Manufacturing Engineering Committee working for the Office of Production Research and Development of the War Production Board has supervised war research projects on milling, has sponsored the development of machines for fusing quartz, and has completed a study of metal cutting at Army Ordnance Arsenals. In the aid of war production, this committee has also issued a great number of data sheets having to do with the cutting of metals. The War Production Committee has maintained its contacts with the War and Navy Departments and has completed several confidential assignments. The Engineering Division of the National Research Council has been in intimate touch with the research and development problems of the war. The Library has been of great value in providing from its foreign records basic material for the use of the armed forces in preparing for the occupancy of conquered countries.

RECONVERSION

The speed with which American industry can be diverted from war to peacetime manufacture depends in great measure on the number of engineers that can be concentrated on the work of perfecting designs for shop use. The Council of the Society has taken notice of the need for modifying government policy and the Selective Service Law to relieve from military service those men who are urgently needed in industry, and of building up the badly depleted reservoir of engineering skill in the country by starting the flow of engineering students in the colleges. A study has been made of these problems and the views of the Council have been expressed in public statements.

The Presidents of the Society during the past two years have addressed communications to our members in the armed forces. The resulting correspondence has shown that many of our members are contemplating changes from their peacetime jobs and are in the need of assistance and guidance, as well as some touches to their education. The Society is planning to meet this need.

INTERNATIONAL RELATIONS

The stoppage of war with its release of international communication has brought renewed activity and interest to the subject of relationships between the engineers of the various countries. In anticipation of this, the Council, early in the year, appointed a Committee on International Relations to cooperate with engineers in other countries. This committee has formulated its program and is prepared to carry on actively.

The war demonstrated the necessity of unifying the engineering standards of Great Britain, Canada, and the United States. At the close of the Society year, a conference in Ottawa, the third in a series, made great progress in securing unified standard screw threads between the three nations. At one of the Ottawa sessions, sponsored by The Engineering Institute of Canada and this Society, Honorary Membership was conferred on Sir William Arthur Stanier, chief mechanical engineer of the London Midland and Scottish Railway.

The co-ordination of standards between the United Nations has been initiated, and at the close of the year a conference was held between the representatives of 14 nations looking to substantial progress.

The Woman's Auxiliary has chosen a student from Chile as the recipient of the Calvin W. Rice Scholarship for 1946.

ADVANCING MECHANICAL ENGINEERING

MEETINGS

The 1944 Annual Meeting, with a registration of 5000, was the best attended in Society history. A series of general sessions dealing with the pressing problems of war and reconversion, 66 technical sessions, and over 100 committee meetings filled five full days.

During the meeting, honors were conferred as follows: Honorary Membership to Charles M. Allen, Lieutenant General Levin H. Campbell, Jr., Gano Dunn, Vice Admiral Emory S.

Land, and Sir (Standen) Leonard Pearce; A.S.M.E. Medal to Edward G. Budd; Holley Medal to Carl L. Norden; Worcester Reed Warner Medal to Earle Buckingham; Melville Medal to Ernest L. Robinson; Spirit of St. Louis Medal to George W. Lewis; Spirit of St. Louis Junior Award to Martin Goland; Charles T. Main Award to Fred M. Piaskowski; and Undergraduate Student Award to Nelson B. Hammond.

Shortly after the Annual Meeting, a transportation ban on similar gatherings was imposed. This led to the encouragement of larger Section meetings at which the papers under preparation could be presented. A large aviation meeting at Los Angeles with 2000 attendants, an Oil and Gas Power meeting at Cleveland, and a three-day Section meeting at Chicago in lieu of the Semi-Annual Meeting resulted. At the close of the year the transportation ban was lifted and plans were implemented for holding an Annual Meeting in 1945, on the usual scale.

The professional public-relations counsel has been continued throughout the year with a marked increase in newspaper reporting of Society activities.

PUBLICATIONS

Paper limitations imposed by the War Production Board continued to handicap the Committee on Publications in its service to members. These limitations were removed in August, but unrestricted use of paper will probably not be possible before 1946.

In spite of limitations on its publication program, the committee continued to lay plans for the future when more paper will be available. It proposed to the Council that the A.S.M.E. News, at present published in MECHANICAL ENGINEERING, be issued monthly as an independent periodical, as soon as editorial staff and paper become available, with the object of providing more Society news to members in a more convenient form. It reaffirmed its intention of restoring to MECHANICAL ENGINEERING the abstract service known for many years as the "Survey," and later as "Briefing the Record," and of making further improvements in the magazine as a service to members and to the engineering profession in general. To this end, an additional appropriation was requested. It distributed to the program-making agencies of the Society a statement on special publications for the purpose of stimulating greater activity in this field.

Revenues from advertising, the Mechanical Catalog, and the sale of publications continued at a high level.

PROFESSIONAL DIVISIONS

The work of the Professional Divisions showed much activity and greatly enlarged scope. In addition to providing the technical programs previously mentioned, a meeting of the Fuels Division with the American Institute of Mining and Metallurgical Engineers Coal Division was held in Charleston, West Va., in the fall of 1944. Other activities of importance by the individual divisions are as follows: Metals Engineering Division has completed its plan for the publication of a "Metals Engineering Handbook;" the Aviation Division celebrated its 25th Anniversary with an enlarged program of activity; the Heat Transfer Division aided in the organization of a Special Research Committee on Gas Properties; the Materials Handling Division stimulated a standardization activity on plant-layout techniques; the Consulting Engineering group, in co-operation with the American Society of Civil Engineers and American Institute of Architects, secured cost data on engineering projects for the Federal Works Administration. This group also participated in a Public Works Construction Advisory Committee and a Committee on Hospital Construction for the Veterans Administration. A section of Transactions to be known as "Materials Engineering" to cover wood, rubber, plastics, metals, and possibly textiles, was given consideration. Active programs on gas turbines and on machine design were in process of organization at the close of the year.

Throughout the year, the work of the divisions was aided materially by the active co-operation of the sections.

SECTIONS

The Committee on Sections has maintained close contact with all sections and has aided wherever possible in membership development and program co-ordination. Sections have shown a substantial growth in membership, and the large number of meetings held and good attendance recorded indicate that generally the Sections are in a healthy condition and have not suffered as a result of the war. Section expenditures have been heavy due to increases in rental costs, printing, etc., and also due to greater joint engineering activity.

Inasmuch as the work of this Committee on Sections will be almost entirely absorbed by the new Vice-Presidents (Regional), it is probable that this year will be the closing chapter in the existence of this committee. The present committee will be retained in being until the new Vice-Presidents are well established in their work.

CIVIC RESPONSIBILITIES

In its efforts to improve the participation of members in civic affairs, the Civic Responsibilities Committee has developed a "yardstick" for measuring the public service rendered by engineering groups and is preparing a manual for the use of the Sections.

LECTURESHIPS

For the first time, official lecturers were selected by the Council to appear before the Sections. Dr. Lionel S. Marks delivered 10 lectures at selected points in the Midwest on gas turbines and jet propulsion. Dr. Stephen Timoshenko, speaking on stress concentration and fatigue failures, delivered his lecture before 13 groups of engineers in the South. Dr. Lillian M. Gilbreth delivered two lectures in the South on "Management's Part in Solving Its Problems." These lectures were excellent and were very well received. They will be continued during 1946.

STUDENT BRANCHES

War has caused the withdrawal of most upperclassmen from college, and about half the Student Branches are inactive. The membership is only about 30 per cent of normal. To bring the branches back to normal operation it will be necessary to do some intensive promotional work. The committee is making plans for this promotional work which, to be effective, must be timed with the return of normal registration in the colleges.

In co-operation with the Mechanical Division of the Society for the Promotion of Engineering Education, a project is under way to collect practical problems from practicing engineers for the use of engineering students.

RESEARCH

Seventeen of the Society's twenty special research committees made progress toward the completion of their projects during the past year.

The "Critical Review and Bibliography on Riveted Joints" was completed and was published recently. A number of new chapters were added to the revision of the A.S.M.E. Manual on Cutting of Metals.

The three committees formed at the request of the Office of the Chief of Ordnance, U. S. War Department, have been active throughout the entire year. The extension of the study

of forging of steel shells was practically completed. The final report on this extended project was made in November. The final report on the manufacture of demolition-bomb bodies was completed and submitted to the War Department in June, 1945. In that same month, the organization meeting of a new Special Research Committee on Machining and Finishing of High Explosive Shells was held. However, preliminary work on this project had been begun by the research staff months before.

During the year two new A.S.M.E. research projects were approved and the committees appointed. These are the Special Research Committee on Properties of Gases and Gas Mixtures, and the Special Research Committee on Automatic Regulation Theory.

STANDARDIZATION

In spite of the limitations placed upon travel and the extraordinary demands made by the Federal Government on all branches of industry, the standards committees sponsored by the Society have made creditable showings this year. Six standards, approximately half the usual number, were completed and approved.

One of the direct results of the close co-operation between the British, Canadian, and American war agencies has been a strong desire to unify the engineering standards of these three countries. Various types of screw threads and pipe threads were the subjects of BCA conferences in New York in December, 1943, in London in August and September, 1944, and had a prominent place on the agenda for the third conference held in Ottawa, September 24 to October 6, of this year. The preparation of material for the use of the United States' delegates at this conference occupied the time of a number of committees and committeemen, to say nothing of our technical committee staff.

The completion of the revision of the American Standard for Pipe Threads (B2.1–1942) and the American Standard for Drawings and Drafting Room Practice (Z14–1935) calls for a special note of commendation. These two projects were carried out under very difficult circumstances in a relatively short time when the extent of the revision in each case and the infinite amount of detail involved are considered.

SAFETY

Because of war activities, work on the national safety codes was in most cases postponed. The safety committees, however, take satisfaction in the knowledge that their activities, extending over the past two decades, produced outstanding results in the war emergency. The comparative accident records of the major war industries indicate that the application of the safety codes developed in the prewar period saved lives, manhours, and equipment that were urgently needed on the fighting fronts.

POWER TEST CODES

While most of the 160 members of the Society's group of Power Test Codes Committees have been busy on special war assignments, they have not neglected their responsibilities in this field. During the year, revisions of "General Instructions" and "Definitions and Values" were completed, approved, and published. The revision of the "Test Code for Stationary Steam-Generating Units" and the "Test Code for Fans" was completed within this period and should shortly become available in printed form.

The Committee on Instruments and Apparatus completed the chapter on "Resistance Thermometers" and made good progress in the development of three new chapters.

BOILER CODE

In the past year, the Boiler Code Committee incorporated its Alternate Rules for Fusion-Welded Boilers in the Power Boiler Section of the Code. This means that the higher design stresses, allowed under the alternate rules during the war emergency, now become the basic minimum Code requirements.

With the cessation of hostilities, it is expected that large tonnages of steel-plate material will be declared surplus and eventually will gravitate to the civilian market. Most of this plate will not comply with any recognized Code specification and frequently will not have any marks of identification. Anticipating a demand for permission to use this material in Code constructions, the committee is now working out the conditions under which it may be used.

THE SOCIETY AND THE PROFESSION

JOINT CONFERENCE COMMITTEE

Organized in 1940, the Joint Conference Committee is made up of the presidents, junior past-presidents, and secretaries of five societies, the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Chemical Engineers. The Joint Conference Committee considers matters of common concern to the societies and makes recommendations to the participants.

During the year, the Joint Conference Committee devoted a large amount of attention to the study of the economic status of the engineer and to the organization of the engineering profession. Both projects are suffering some delay because of the change from war to peace, but it is confidently expected that they will come to a close during the coming year.

Following the statement of September 29, 1944, of the presidents of the five societies, proposing a plan for controlling productive capacity in postwar Germany, a special committee was appointed to continue the investigation. This committee reported in September, 1945, with concrete suggestions for controlling the important industries of Germany.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

The Engineers' Council for Professional Development (E.C.P.D.), organized in 1932, to enhance the status of the engineer, is composed of three representatives each of eight engineering bodies: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, The Engineering Institute of Canada, the Society for the Promotion of Engineering Education, American Institute of Chemical Engineers, and the National Council of State Boards of Engineering Examiners.

During the year, the principal activity of E.C.P.D. was the preparatory organization necessary to carry on the program of accrediting technical institutes.

The E.C.P.D. is continuing is efforts to secure adherence by the major engineering societies to a joint code of ethics. This Society has accepted the new code with some editorial modifications.

The Carnegie Foundation is continuing the research on the Pre-Engineering Inventory—a battery of tests of ability to pursue an engineering education.

ENGINEERING FOUNDATION

The Engineering Foundation was established in 1914, as a result of the first of a series of gifts from Ambrose Swasey.

The purpose of this foundation is "The furtherance of research in science and engineering and the advancement in any other manner of the profession of engineering and the good of mankind." The corpus of the gifts remains intact; only the income from the investments is used for the support of research projects. The control of this income and of the researches remains in The Foundation Board, composed of representatives of the Founder Societies. All projects are sponsored by one or more of these societies.

The Foundation granted support to the following four projects, sponsored by this Society: Metal Cutting Data, Strength of Metals, Plastic Flow of Metals (Rolling Steel), Fluid Dynamic Problems in the Design and Operation of Turbines and Compressors.

The Foundation also contributed $5000 to the activities of E.C.P.D.

UNITED ENGINEERING TRUSTEES, INC.

The Trustees are charged with maintaining the joint building of the profession, and the funds for the Engineering Foundation and the Engineering Library.

Perhaps the outstanding problem which has presented itself to the Trustees has been the increasing diversification of activities of the Founder Societies, as well as their unprecedented growth in membership which has created an urgent requirement for more office space in the Engineering Societies Building today and for the future. A study of means to meet this demand has engaged the active attention of the Board of Trustees during this year.

The Trustees have employed engineers, real-estate experts, and architects to advise them before arriving at any conclusion to present to the Founder Societies for their approval.

REGISTRATION

There are now 75,000 registered engineers in the various states. Montana and New Hampshire are the only states which do not have a registration law. The District of Columbia has a law under consideration.

The Illinois Supreme Court decided that the Illinois Registration Law is unconstitutional. A revised law has just been adopted. In Montreal, the Superior Court of Quebec decided that a consulting engineer violated the law by designing a building to house special machinery.

Revisions of the model law were agreed upon at a conference of representatives of fourteen engineering societies called by the American Society of Civil Engineers. These revisions must be approved by the governing boards of all societies concerned.

EMPLOYMENT SERVICE

The Society co-operates with the three founder societies in the operation of Engineering Societies Personnel Service, Inc., offices of which are located in New York, Chicago, Detroit, and San Francisco. During the war, this service was not able to fill the demands from industry for competent engineers. During the reconversion period, this service can render splendid assistance to the members who are seeking employment.

THE ADMINISTRATION OF THE SOCIETY

THE PRESIDENT, COUNCIL, AND EXECUTIVE COMMITTEE

The Council met twice; at the Annual Meeting in November, 1944, and in connection with the Semi-Annual Business Meeting held in Chicago, in June, 1945. The Executive Committee met eleven times during the fiscal year.

Visits to Student Branches and Sections by the officers and members of the Council were less frequent than usual because of the limitations on transportation and the great effort being devoted individually to war production.

CHANGES IN ORGANIZATION

A Special Committee on Society Organization Structure was appointed in November, 1943. The recommendations of this Committee, made during the summer and fall of 1944, were as follows:

1 To change the Constitution so that the Council would be made up of eight Vice-Presidents, one from each Region, and eight Directors-at-Large, instead of the present seven Vice-Presidents and nine Managers.

2 A suggested form of Committee structure by which the related committees will be grouped under Boards.

3 Recommendation of policies for operation of the Secretary's office.

The new setup of the Council was approved by letter ballot of the membership and will be put into effect by the new officers who assume their duties in November, 1945.

The Committee on Society Organization Structure had finished its work and was discharged. A Standing Committee on Organization has been set up to give over-all supervision to society organization, committee personnel, and the Secretary's office organization and personnel. To this committee has been assigned the task of developing detailed plans for the general scheme of organization recommended by the Committee on Society Organization Structure. The preliminary work on a proposed Board on Codes and Standards has been approved and is now being formulated into changes of the by-laws for consideration by the Council at the November, 1945, Annual Meeting. This committee has devoted a great amount of time to the problem of Society Committee personnel. A statement of fundamental principles has been developed, and detailed procedures are being worked out in the Secretary's office.

FINANCES

The complete report of the Finance Committee follows and is a part of this report of the Council. It shows a large increase in Society income, compared to the previous year, and a substantial gain in its financial stability.

During the year a Development Fund was established to provide a separate source of funds for the technical work of the Society. The plan is to use this fund for those projects which can develop an income and return withdrawals to the fund. This fund should not be confused with specific solicitations for individual research projects. It does not cover any specific endeavor or research work for a particular industry or problem. The amount in the fund at the end of the year was $92,904.

WOMAN'S AUXILIARY

The Woman's Auxiliary has progressed during the year, particularly the four sections at Cleveland, Los Angeles, Philadelphia, and New York. The Student Loan Fund is in excellent condition with nearly $7000 available for loan, and ten loans outstanding, only one of which is of doubtful value. The Calvin W. Rice Scholarship is being awarded regularly, this year to a student from Chile.

DELEGATES AND GROUP DELEGATES CONFERENCES

The usual meetings of delegates from Sections were held in eight areas during the fall of 1944, and two representatives from each area met in a Group Delegates Conference during the 1944 Annual Meeting. In addition to discussing important administrative problems, the delegates gave a great deal of time to the proposed changes in the Constitution and partici-

TABLE 1 CHANGES IN MEMBERSHIP

(Sept. 30, 1944, to Sept. 30, 1945)

	Membership		Increases			Decreases				Changes		
	Sept. 30, 1945	Sept. 30, 1944	Transferred to	Elected	Reinstated	Transferred from	Resigned	Dropped	Died	Increases	Decreases	Net change
Honorary members	36	31	2	3						5		+ 5
Fellows	172	148	29			2			3	29	5	+ 24
Members	9607	8791	125	865	126	28	41	79	152	1116	300	+ 816
Associates	245	224	1	26	3	3	1	3	2	30	9	+ 21
Junior (20)	2197	1301	935	69	37	69	18	56	2	1041	145	+ 896
Junior (15)	1776	1257	835	104	27	375	16	55	1	966	447	+ 519
Junior (10)	5655	6583		684	92	1450	26	221	7	776	1704	− 928
Total membership	19688	18335	1927	1751	285	1927	102	414	167	3963	2610	+1353

pated actively in the business meeting of the Society at which these constitutional changes were discussed.

The proposed scheme of Regional Vice-Presidents pointed to the desirability of having the area delegates meet prior to the Semi-Annual Meeting in Chicago, so that their views could be recorded on the new scheme of organization and the personnel to be selected for the Council. Further consideration brought out the desirability of changing the delegates' meeting from the fall to the spring and, accordingly, a second series of meetings was held in the spring, leading to a Group Delegates Conference in Chicago in June. The general desirability of the new arrangement is well established and it will be followed in future years.

MEMBERSHIP

By modification of the Constitution the requirements for the Member grade have been clarified and broadened by omitting the minimum age limit, and by specifying that a member shall be qualified to direct engineering work or to carry on important research or design in the field of engineering.

The Committee on Admissions held eleven regular monthly meetings and one special meeting during the fiscal year 1944–1945. Action taken by the committee is tabulated as follows:

Applications pending, Oct. 1, 1944	355
Applications received during the fiscal year 1944–1945	2349
Total applications handled during the year 1944–1945	2704
Recommended for membership	2131
Transfers denied	6
Deferred	12
Withdrawn, incomplete, and canceled	18
Deceased	0
Applications pending September 30, 1945	537
Total applications handled during the year 1944–1945	2704
The 2131 recommended for membership were divided into the following grades:	
Transfers to Fellow	25
Members	612
Transfers to Member	159
Transfers to Associate	1
Associates	30
Juniors	353
Transfers from Student-Member to Junior	951
Total Recommended	2131
Transfers	185
	1946

BOARD OF REVIEW

The Board of Review made 396 recommendations to the Council as follows:

	1944–45	1943–44	1942–43
Cancellation of dues	8	0	3
Resignations	112	120	157
Reinstatements	151	135	224
Reinstatements voided	20	0	0
Previous dropped or resigned actions rescinded	105	81	65

MEMBERSHIP DEVELOPMENT

The Society membership on September 30, 1945, was 19,688, as compared with 18,335 on October 1, 1944; 17,485 in 1943, and 16,613 in 1942. A Committee on Membership Development has been established with representation of the Sections, Professional Divisions, and Technical Committees. Changes in membership are given in Table 1.

PENSIONS

By the largest letter-ballot vote of the membership, a Pension Plan for the Secretary's office was approved on March 19, 1945; 6779 favored the plan and 268 members voted against it. Immediately thereafter a Pension Committee of three members was established. An insurance adviser was selected and the State Mutual Life Insurance Company, Worcester, Mass., was chosen to write the annuity contracts provided in the plan. Rules and regulations were prepared and were approved by the Executive Committee of the Council in May and at the close of the year the retirement plan was in full operation.

CONSTITUTION AND BY-LAWS

As was reported under other headings, the Constitution was amended during the current year to change the composition of the Council, to change the qualifications for the Member Grade, and to omit the word "local" before Sections throughout the Constitution, and to change Student-member to Student Member. A proposal to establish a new grade of membership, the Executive Member, was disapproved by the members.

Further recommendations to carry out the changes in organization structure by changes and by-laws are in course of preparation.

THE SECRETARY'S OFFICE

During the Annual Meeting, honoraria were given and the appreciation of the Society expressed to five members of the staff who have served 25 years or more. In order of service they were: Joseph M. Clark, Vina E. Jillson, Mae R. Lenen, Edna M. Murrayes, Mabel C. Smith.

During the year Miss Janet E. Bachman, who was just reach-

ing 25 years of service, died after a long illness. Miss Bachman was well known to many of the members attending the meetings of the Society.

The leaves of absence of the Secretary, Colonel C. E. Davies, and Lieut. Col. Leslie Zsuffa were extended for the year. However, during the latter part of the year, Colonel Zsuffa was discharged from the Army and accepted another position.

Mr. C. B. Le Page, Assistant Secretary, who had been loaned for part-time work in the Conservation Division of the War Production Board, completed his work in that division but later was made available for aid from time to time to the Combined Production and Resources Board to plan the International Screw Thread Standardization Conference to be held in Ottawa at the close of the Society year.

COMMITTEE REPORTS

The complete reports of the committees of the Society and of its representatives on joint agencies are embodied in a pamphlet of 64 pages which is available upon request.

DEATHS

Two former officers of the Society were lost through death during the year: William B. Gregory, Manager, 1916–1919 and Vice-President, 1920–1921 and 1931–1933; Hollis P. Porter, Manager, 1921–1924.

A.S.M.E. FINANCE COMMITTEE REPORT, 1944-1945

THE function of the Finance Committee of the A.S.M.E. is sixfold:

1 The preparation of an annual budget closely estimated in advance, and reviewed monthly to meet variation of actual income and expenditure.

2 Close co-operation with the Council in its efforts to maintain and develop the usefulness of existing departments, and in the establishment of such other new activities as experience and changing conditions dictate and the membership through representative channels may request.

3 The maintenance at all times of comprehensive and accurate records insuring data to be constantly available to the committee for its guidance of the Council and Officers of the Society in their directed activities.

4 The operating control of assets and income of the Society, its investments, transfers or sales—all subject to the approval of the Council.

5 Preparation of an annual report of the Society's complete financial condition, in accepted accounting form, and also in descriptive form to cover those features not of definite bookkeeping character, but of special interest to the membership.

6 There are other activities such as the Employees' Pension Plan but these are special and vary from time to time.

From the foregoing it is obvious that the Council inherently and by constitutional direction is the originating or accelerating body, while the Finance Committee is the means called on to budget the funds to meet the many and constantly recurring requests for essential money. It must, therefore, of necessity act as the agent through whom committee activity demands are weighed against income less the fixed expenses and to maintain a proper balance. It must see that we "live within our means" with due consideration to reserves for the inevitable "rainy day."

This has been done through the fine co-operation between the Council and the Committee. The Council informs that a certain action is under consideration and requests the Finance Committee to make recommendations as to funds. The Committee studies the budget and existing obligations and recommends favorably if funds appear available, or can be obtained by transfer from other activities, and states what changes would be involved.

Further, the Finance Committee must have a definite policy or program at all times and be looking well ahead to anticipate the trend of industry, business, and the investment market, to avoid being caught with heavy reduction in income and long term obligations, thus forcing the discontinuance of vital Society activities.

It was for this reason that four years ago the Committee undertook the serious accumulation of a substantial "future operation surplus." At the present, this amounts to approximately $490,000, a sum we estimate to be sufficient to carry on the Society's essential activities through a depression period.

For the same reason, before and during the war, the Committee has made and is making investments in marketable Government bonds that can readily be turned into cash when needed. It is expected to continue this policy during the next fiscal year.

The character of the Society's holdings for general Society trust funds and various other trusts and reserve funds is shown by the following table:

Securities	Lower of cost or market
U. S. Government Securities	$ 834,004.48
Stocks and Bonds	34,679.45
Real Estate Mortgages and Certificates	24,117.80
	$ 892,801.73
Cash	159,866.31
TOTAL	$1,052,668.04

Respectfully submitted,

J. J. SWAN, *Chairman*
W. H. SAWYER, *Vice-Chairman*
J. NOBLE LANDIS
G. L. KNIGHT
F. E. LYFORD
A. C. CHICK } *Council*
A. J. KERR } *Representatives*
K. W. JAPPE, *Treasurer*

OPERATING SUMMARY

A Balance Sheet. Accountants' Certificate
B Comparative summary of income and expense
C Statement of surplus
D Statement of changes in funds
E Detailed cost of activities
F How the A.S.M.E. spent its 1944–1945 income.

The Balance Sheet, Exhibit A, of September 30, 1945, shows, on that date, that the Society owed:

(1)	Current bills and Federal Tax withheld from Employees	$ 10,018.02
(2)	Obligations for printing and distributing the 1946 Mechanical Catalog, bills for which have not been submitted	32,642.32
(3)	Other obligations for which bills have not been submitted	2,985.00
(4)	Unexpended appropriations for future services	97,713.25
(5)	Special research and other committees which have collected funds for special purposes to be expended as needed	65,929.96
(6)	Future services to members who have prepaid dues	109,082.42
(7)	Advertisers and subscribers to publications who have paid	4,238.00
		$322,608.97

To meet these debts the Society had:

(1)	Cash in the bank	$110,507.88
(2)	Accounts receivable	115,216.59
(3)	Inventories of publications and supplies conservatively valued at	30,405.27
(4)	Securities (at the lower of cost or approximate quoted market values)	558,466.79
		$814,596.53

The difference between the value held by the Society of $814,596.53 and debts of $322,608.97 is net worth of the Society on September 30, 1945 ..... $491,987.56

The Society had other liabilities:

(1)	Trust funds amounting to ..... against which the Society had the following assets:		$145,873.25
	(a) Cash	$ 13,667.99	
	(b) Notes receivable	255.00	
	(c) Securities (at the lower of cost or approximate quoted market values)	131,950.26	
		$145,873.25	
(2)	Property fund of ..... with the following assets to support it:		$535,221.86
	(a) Quarter interest in building	$498,448.48	
	(b) Office furniture and fixtures (depreciated value)	36,771.38	
	(c) Library books	1.00	
	(d) Engineering Index, Inc.—Title and good will	1.00	
		$535,221.86	
(3)	Employees' Retirement Fund of ..... covered by:		$144,539.45
	(a) Cash	$ 30,256.33	
	(b) Securities (at the lower of cost or approximate quoted market values)	114,283.12	
		$144,539.45	
(4)	Development Fund of		$ 93,535.67
	(a) Cash	$ 5,434.11	
	(b) Securities (at the lower of cost or approximate quoted market values)	88,101.56	
		$ 93,535.67	

EXHIBIT A—BALANCE SHEET—SEPTEMBER 30, 1945

ASSETS

GENERAL FUND:			
Cash in banks and on hand			$ 110,507.88
Accounts receivable:			
Dues—current year	$ 9,724.11		
Dues—prior years	145.80		
	$ 9,869.91		
Less—Reserve	9,869.91		
Publications and advertising	$107,840.06		
Less—Reserve	2,697.48	$105,142.58	
Miscellaneous		10,074.01	115,216.59
Inventories, at cost or less:			
Publications completed		$ 12,043.13	
Publications in process		16,703.91	
		$ 28,747.04	
Less—Reserve		4,078.06	
		$ 24,668.98	
Supplies		5,736.29	30,405.27
Securities:			
Real estate mortgage and mortgage certificate (cost $35,688.06)		$ 21,617.80	
United States of America Savings Bonds, Series F and G (at current redemption values)		257,656.78	
United States of America Treasury Bonds (at cost)		279,192.21	558,466.79
			$ 814,596.53
DEVELOPMENT FUND:			
Cash in banks		$ 5,434.11	
United States of America Treasury Bonds (at cost)		88,101.56	93,535.67
EMPLOYEES' RETIREMENT FUND:			
Cash in banks		$ 30,256.33	
United States of America Savings Bonds, Series F (at current redemption values)		36,034.38	
United States of America Treasury Bonds (at cost)		78,248.74	144,539.45
TRUST FUNDS:			
Cash in banks		$ 13,667.99	
Note receivable (Major Toltz Fund)		255.00	
Securities (at lower of cost or approximate quoted market values):			
Public utility and railroad stocks and bonds	$ 34,679.45		
Real estate mortgage	2,500.00		
United States of America Savings Bonds, Series G (at current redemption values)	60,078.00		
United States of America Treasury Bonds	34,692.81	131,950.26	145,873.25
PROPERTY FUND:			
One-fourth interest in real estate and other assets of United Engineering Trustees, Inc., exclusive of Trust Funds		$498,448.48	
Office furniture and fixtures (depreciated value)		36,771.38	
Library books		1.00	
Engineering Index, Inc.—Title and good will		1.00	535,221.86
			$1,733,766.76

LIABILITIES

GENERAL FUND:		
Accounts payable		$ 828.63
Federal income tax withheld from employees		9,189.39
Accrued liabilities:		
Estimated liability relating to Mechanical Catalog 1945–1946	$ 32,642.32	
Other accrued liabilities (estimated)	2,985.00	35,627.32
Unexpended balances of Custodian Funds		65,929.96
Deferred credits:		
Dues and initiation fees paid in advance	$109,082.42	
Prepaid subscriptions (estimated)	4,000.00	
Prepaid advertising	238.00	113,320.42
Reserve for unexpended appropriations:		
Year ending September 30, 1945	$ 77,880.12	
Prior years	$ 19,833.13	97,713.25
Surplus (Exhibit C)		491,987.56
		$ 814,596.53
DEVELOPMENT FUND (Exhibit D)		93,535.67
EMPLOYEES' RETIREMENT FUND (Exhibit D)		144,539.45
TRUST FUNDS, including unexpended income (Exhibit D)		145,873.25
PROPERTY FUND		535,221.86
		$1,733,766.76

NOTE: Initiation and promotion fees receivable are not included in the above statement as they are taken up by the Society only as and when collected.

EXHIBIT B

COMPARATIVE SUMMARY OF INCOME, EXPENSES, AND APPROPRIATIONS

For the Two Years Ending September 30, 1945

	Year 1943–1944	Year 1944–1945
INCOME:		
Initiation and promotion fees (to surplus)	$ 19,655.00	$ 21,416.86
Membership dues*	$257,597.53	$273,698.96
Student dues	12,279.00	10,182.91
Interest (net of discounts allowed in the year 1943–1944 of $3,948.07; discounts allowed in the year 1944–1945 charged against advertising income)	4,205.51	10,912.08
MECHANICAL ENGINEERING advertising	246,070.02	308,327.98
Mechanical Catalog advertising	83,199.10	102,343.77
Publication sales	104,254.98	95,403.19
Miscellaneous sales	2,491.02	3,646.68
Engineering Index, Inc.	1,356.60	1,622.52
Registration fees	1,113.00	748.00
Sale of equipment	75.00	725.00
Membership list advertising	1,029.00	
TOTAL INCOME	$713,670.76	$807,611.09
EXPENSES AND APPROPRIATIONS:		
Expenses under committee supervision (including appropriation of $5000 to Employees' Retirement Fund in 1943–1944 and $19,000 in 1944–1945)	$ 99,934.41**	$118,830.29**
Publication expense	210,868.85	209,058.86
Office expense	316,594.56	379,393.43
Total expenses and appropriations***	$627,397.82	$707,282.58
EXCESS OF INCOME OVER EXPENSES AND APPROPRIATIONS	$ 86,272.94	$100,328.51

* Membership dues have been stated on the basis of total cash received during the year.

** Includes assessment by United Engineering Trustees, Inc., of $6,828.75 in 1943–1944, and $6,828.76 in 1944–1945 for building operating deficit.

*** Includes unexpended balances at September 30, 1944, and September 30, 1945, of appropriations made in the respective years then ending, as follows:

	1943–1944	1944–1945
Expenses under committee supervision	$11,872.88	$ 8,270.58
Publication expense	6,924.99	19,080.29
Office expense	20,614.35	50,529.25
	$39,412.22	$77,880.12

EXHIBIT C

STATEMENT OF SURPLUS

Year Ending September 30, 1945

BALANCE, SEPTEMBER 30, 1944		$390,000.00
ADD:		
Initiation and promotion fees collected		21,416.86*
Excess of income over expenses and appropriations for the year (Exhibit B)		100,328.51
Unexpended balances of prior years' appropriations		904.79
Collections on account of claims against guarantors of mortgage participation certificates		329.67
		$512,979.83
DEDUCT:		
Adjustment of carrying value of United States of America Savings Bonds, Series G, to current redemption value at September 30, 1945	$ 542.00	
Appropriation to Trust Fund to establish paid-up life membership dues on basis of 2½% annual interest	450.27	
Special appropriation to Employees' Retirement Fund	20,000.00	
		20,992.27
BALANCE, SEPTEMBER 30, 1945		$491,987.56

* As it is the practice of the Society to take up initiation and promotion fees only as and when collected, the above statement does not include such fees receivable at September 30, 1945.

ACCOUNTANTS' CERTIFICATE

TO COUNCIL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

We have examined the balance sheet of The American Society of Mechanical Engineers as of September 30, 1945, and the summary of income, expenses, and appropriations and statements of surplus and changes in funds for the fiscal year ending that date. Our examination was made in accordance with generally accepted auditing standards applicable in the circumstances, and included such tests of the accounting records and other supporting evidence and such other procedures as we considered necessary.

In accordance with the practice followed by the Society in prior years, no effect has been given in the statements to accrued income on investments.

The membership dues are included in the income account of the current year on the basis of total cash received on account of that year and prior years and provision has been made for all dues uncollected at September 30, 1945.

In our opinion, the accompanying balance sheet and related summary of income, expenses and appropriations and statements of surplus and changes in funds present fairly the position of The American Society of Mechanical Engineers at September 30, 1945, and the results of its operations for the fiscal year on the basis indicated in the foregoing paragraphs and the appended statements.

(Signed) PRICE, WATERHOUSE & Co.

New York, N. Y.
November 14, 1945

EXHIBIT D STATEMENT OF CHANGES IN FUNDS

Year Ending September 30, 1945

DEVELOPMENT FUND			**TRUST FUNDS**			
Balance, September 30, 1944		$13,413.40	Balance, September 30, 1944			$127,424.77
Deduct—Transfer to Trust Funds, as authorized by Executive Committee of The Council		13,413.40	*Add:*			
			Income from investments			3,555.62
Contributions		$ 92,904.00	Interest on savings bank deposits			123.40
Interest on bonds (net of interest purchased $520.26)		653.42	Interest on notes receivable			26.38
		$ 93,557.42	Profit on sales of investments			2,057.72
Deduct—Investment custodian fees		21.75	Contributions to:			
Balance, September 30, 1945		$ 93,535.67	Gantt Medal Fund	$ 637.04		
			Percy Nicholls Award Fund	1,250.00		
EMPLOYEES' RETIREMENT FUND			Charles T. Main Award Fund	865.00		
Balance, September 30, 1944		$130,786.18				2,752.04
Add:			Transfer from Development Fund			13,413.40
Income from investments		2,745.14	Life memberships purchased			1,540.04
Interest on savings bank deposits		50.13	Appropriation from General Fund surplus to establish paid-up life membership dues on basis of 2½% annual interest			450.27
Appropriations from:						$151,343.64
General Fund income	$19,000.00		*Deduct:*			
General Fund surplus	20,000.00		Expenditures for prize awards, etc.	$3,037.61		
		39,000.00	Proportion of life membership dues transferred to General Fund income	745.00		
		$172,581.45	Adjustment of carrying value of investments in stocks and bonds to lower of cost or approximate market value of such stocks and bonds at September 30, 1945	1,642.63		
Deduct:			Investment custodian fees	45.15		
Payments to State Mutual Life Assurance Co.	$28,569.78					5,470.39
Less—Amount charged directly to expenses under committee supervision	569.78	$28,000.00	Balance, September 30, 1945			$145,873.25
Investment custodian fees		42.00				
		28,042.00				
Balance, September 30, 1945		$144,539.45				

EXHIBIT E—DETAILED COST OF A.S.M.E. ACTIVITIES 1944–1945

(Approved by Finance Committee October 19, 1945)

	Expense under committee supervision	Printing and distribution expense	Office expense	Total cost 1944–1945	Total cost 1943–1944
Council	$ 4,955.73			$ 4,955.73	$ 4,575.00
Library	10,096.40			10,096.40	9,830.91
U.E.T. Deficit	6,828.76			6,828.76	6,828.75
Smith Survey—Status of the Engineer	500.00			500.00	3,500.00
Engineers' Council for Professional Development	2,050.00			2,050.00	2,050.00
International Management Congress	500.00			500.00	
National Management Council	200.00			200.00	
Finance Committee					115.00
Awards	729.34		$ 553.71	1,283.05	1,696.07
Nominating Committee	1,535.93			1,535.93	912.00
Sections	35,638.85		10,246.81	45,885.66	34,438.40
Lectureships	2,000.00			2,000.00	3,000.00
Meetings and Program	14,519.00		12,918.73	27,437.73	27,826.58
Professional Divisions	3,914.26		12,918.73	16,832.99	17,450.62
Admissions			10,407.60	10,407.60	10,301.80
Employment Reserve	2,000.00			2,000.00	2,000.00
Student Branches	5,686.24	$ 4,141.87	6,161.36	15,989.47	15,651.52
Technical Committees	999.97		33,227.01	34,226.98	25,556.22
MECHANICAL ENGINEERING Text Pages		29,000.00	16,879.25	45,879.25	40,744.73
Transactions and *Journal of Applied Mechanics*	177.25	37,200.00	20,259.26	57,636.51	53,372.96
Membership List		9,000.00	1,300.00	10,300.00	13,185.45
MECHANICAL ENGINEERING Advertising Pages		52,654.07	63,984.59	116,638.66	98,102.64
A.S.M.E. Mechanical Catalog		38,400.00	44,919.23	83,319.23	67,406.35
Publication Sales		38,662.92	14,198.56	52,861.48	63,685.11
Retirement Fund	22,269.78			22,269.78	7,700.00
Professional Services	1,713.68			1,713.68	1,798.50
Membership Development	2,500.00			2,500.00	2,500.00
Organization Charts	15.10			15.10	616.58
Secretary's Office			31,751.64	31,751.64	24,236.10
Accounting			26,680.65	26,680.65	21,482.60
General Service			49,986.83	49,986.83	35,831.70
General Office			22,999.47	22,999.47	31,002.23
	$118,830.29	$209,058.86	$379,393.43	$707,282.58	$627,397.82

How the A.S.M.E. Spent Its Income in 1944–1945

EXHIBIT F

Dues Income: $273,698.96—$13.90 per Member.

The principal item of income is the dues paid by the members. Juniors pay $10, $15, or $20 depending upon their age; Members pay $20, Fellows, $25, except that those who have been on the rolls of the Society for 35 years or who have reached 70 and have been members 30 years are carried without dues. On September 30 the Society had 19,688 members on its rolls and during the year $273,698.96 was collected in dues. The per-member dues income is therefore $13.90.

The publications of the Society are MECHANICAL ENGINEERING, Transactions, including the *Journal of Applied Mechanics*, the Membership List, and the A.S.M.E. Mechanical Catalog and Directory. Income is obtained from advertising in MECHANICAL ENGINEERING and in the Catalog. An income and expense statement for the publications appears below.

PUBLICATIONS

	Direct expense	Income
MECHANICAL ENGINEERING	$162,517.91	$308,327.98
Transactions (including *Journal of Applied Mechanics* and Membership List)	67,936.51	
A.S.M.E. Mechanical Catalog	83,319.23	102,343.77
Publications sold	52,861.48	95,403.19
	$366,635.13	$506,074.94
Indirect Expense	72,255.18	
	$438,890.31	
Income	506,074.94	
Net income from publications	$ 67,184.63	
Total expense of publications per member	22.29	
Income from publications per member	25.70	
Net income per member	$ 3.41	

Technical Committee Work: Net Expense $42,079.09—$2.14 per Member.

The Society has over four hundred technical committees engaged in the work on research, establishing power test codes, preparing the boiler code, and preparing standards and safety codes. The work of these committees is supported by direct staff expense which in 1944–1945 was $34,226.98. Adding to it indirect general expense of $7,852.11 gives a total expense of $42,079.09, which on a per-member basis is $2.14. The principal output of the technical committees is publications which are sold to members and to others. This figure of expense should therefore be considered in relation to the publication expense of the Society.

General Society Activities: Net Expense $132,364.09—$6.72 per Member.

The general activities of the Society include the holding of meetings, the operation of Local Sections, Professional Divisions, Student Branches, the administration of the procedure for admitting members to the Society, and the bestowal of awards.

The Society receives income from students for their membership in the Society. The following tabulation shows the net expense for this activity:

GENERAL SOCIETY ACTIVITY

	Direct expense	Income
Society Meetings	$ 27,437.73	$ 748.00
Sections	45,885.66	
Professional Divisions	16,832.99	
Student Branches	15,989.47	10,182.91
Admissions	10,407.60	
Awards	1,283.05	
Lectureships	2,000.00	
	$119,836.50	$10,930.91
Indirect Expense	23,458.50	
	$143,295.00	
Less Income	10,930.91	
Net cost of general Society activities	$132,364.09	
Total expense of general Society activities per member	7.28	
Income per member	.56	
Net expense per member	$ 6.72	

Joint Activities: Net Expense $36,148.68—$1.83 per Member.

The Society also participates in a number of joint activities such as the Library, Engineers' Council for Professional Development, and the joint Employment Service. In addition to the payments to these joint bodies for these purposes a certain amount of general expense is allocated to these activities. The following tabulation gives the total of this expense:

JOINT ACTIVITIES

	Direct expense
Engineering Societies Library	$10,096.40
Engineers' Council for Professional Development	2,050.00
United Engineering Trustees (Deficit)	6,828.76
Smith Survey—Status of the Engineer	500.00
Employment Service (Reserve)	2,000.00
International Management Congress	500.00
National Management Council	200.00
	$22,175.16
Indirect Expense	13,973.52
Total cost of joint activities	$36,148.68
Expense per member	$ 1.83

Administration: Net Expense $29,963.22—$1.52 per Member.

In carrying out the Society activities, certain administrative services must be provided. These include the expense of the Council, the Nominating Committee, and the provision for auditing, legal, and other services. Certain general income is received. The following tabulation shows the amount of this expense and income:

GENERAL SOCIETY ADMINISTRATION

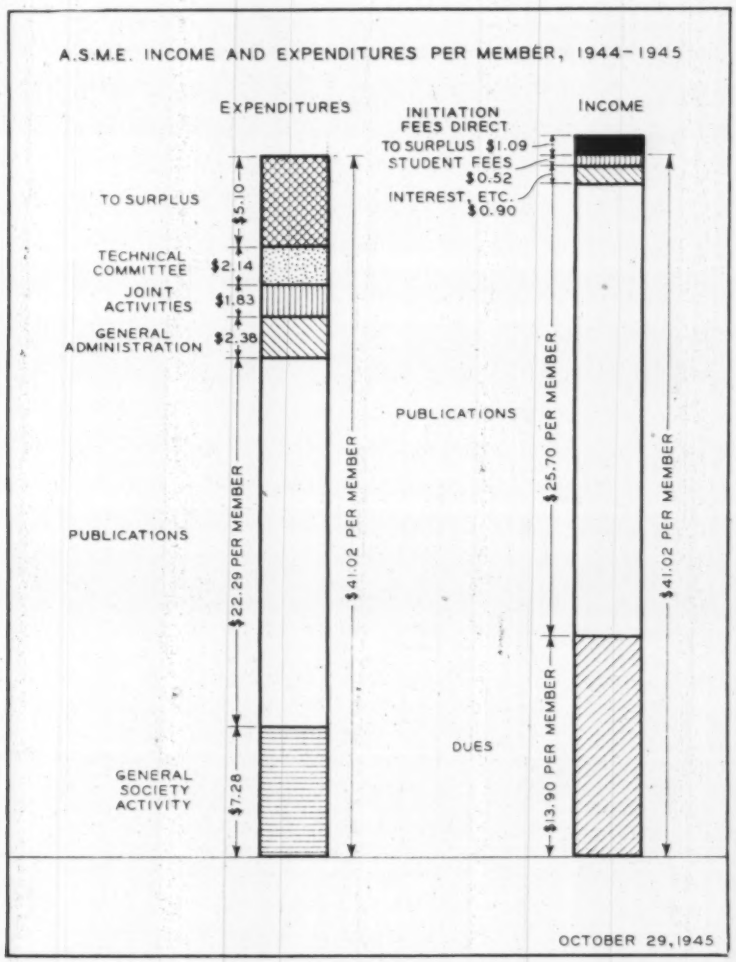
	Direct expense
Council	$ 4,955.73
Organization Charts	15.10
Membership Development	2,500.00
Retirement Fund	22,269.78
Professional Services	1,713.68
Nominating Committee	1,535.93
	$32,990.22
Indirect Expense	13,879.28
	$46,869.50
Income from interest and miscellaneous	16,906.28
Net cost of general Society administration	$29,963.22
Expense per member	2.38
Income per member	.86
Net expense per member	$ 1.52

RECAPITULATION

	Expenses	Income
Dues	$	$273,698.96
Publications	438,890.31	506,074.94
General Society Activity	143,295.00	10,930.91
Technical Committee Work	42,079.09	....
General Society Administration	46,869.50	16,906.28
Joint Activities	36,148.68	....
	$707,282.58	$807,611.09
Addition to surplus from operating income	100,328.51	
	$807,611.09	

INCOME AND EXPENSE PER MEMBER

	Expense per member	Income per member	Net expense per member
Dues	$....	$13.90	$...
Publications	22.29	25.70	3.41
General Society Activity	7.28	.56	6.72
Technical Committee Work	2.14	....	2.14
General Society Administration	2.38	.86	1.52
Joint Activities	1.83	....	1.83
	$35.92	$41.02	
Addition to surplus from operating income	5.10		
	$41.02		



FIRST POSTWAR A.S.M.E. ANNUAL MEETING

Crowded Sessions at Hotel Pennsylvania, New York, N. Y., Bring Out Great Volume of Technical Material

ALTHOUGH decision to hold the 1945 Annual Meeting of The American Society of Mechanical Engineers was taken late in September, after the Office of Defense Transportation had relaxed its ban on conventions, and the time for preparations was thus severely limited, a meeting of maximum size in so far as attendance and number of events were concerned was successfully conducted at the Hotel Pennsylvania, New York, N. Y., November 26–29. The registration figures reveal an attendance of over 4000, about the same as that of 1944, and the program, although compressed into one less day, afforded more than 60 technical sessions and in excess of 20 public luncheons and dinners. Sessions began on Monday morning and were conducted every evening with the exception of Tuesday, at which time the Annual Dinner was scheduled. In addition to the technical sessions a great number of committee meetings were scheduled, some combined with luncheons and dinners. Some of these committee meetings were held on Sunday and others on Friday, but the majority of them were conducted simultaneously with the technical sessions throughout the week. Members were also privileged to take part in scheduled plant visits; the usual "college reunions" were held; the Council conducted its affairs, as reported on pages 79–81 of the A.S.M.E. News Section of this issue; and the Woman's Auxiliary provided a special program for the women in attendance. On Friday a group of about 50 members went to the Aberdeen Proving Ground to inspect the supersonic wind tunnel of the Ordnance Department, described in an article in the December issue, pages 827–833, 835, and to discuss technical papers dealing with various phases of the tunnel design and equipment.

Delay in decision to hold the 1945 Annual Meeting necessarily delayed receipt of the manuscripts scheduled for presentation at the technical sessions and hence it was impossible to preprint a majority of these papers. Of the papers that were preprinted, only a few were received in time to be put into type. The others were either mimeographed or reproduced by the photolithograph process directly from the typescripts submitted by the authors; and for many of these preprints the Society is indebted to the generosity and initiative of the authors themselves who performed this service when it became apparent that the Society's printers were too busy to handle the volume of work offered to them on short notice.

The tentative program of the meeting, printed in the November issue of MECHANICAL ENGINEERING, turned out to be both incomplete and inaccurate because it was in process of being organized at the time of printing. Unexpected changes were made necessary after the program had gone to press because it became apparent that the redecoration of the ballroom of the Hotel Pennsylvania would not be completed in time for the scheduled Annual Dinner on Wednesday night. This necessitated a last-minute shift to the ballroom of the Hotel Astor, which, it developed, was available only on Tuesday night. Hence a rearrangement of the program had to be undertaken with many shifts of sessions and other events. These changes, made in many cases after announcements had been published of times and places of sessions, luncheons, and dinners, were accepted with very good grace by the many persons affected, and the Society is grateful to its members for cooperation and sympathetic understanding of the difficulties which were encountered and overcome.

A complete account of the meeting cannot be written, nor would it serve any good purpose other than that of presenting a historical report of all the events of a full and strenuous week. Attention in what follows is directed principally to the public and nontechnical events. The technical sessions were, as usual, devoted to the presentation and discussion of papers that will, in the main, be published in coming months in MECHANICAL ENGINEERING, Transactions, and the *Journal of Applied Mechanics*.

ACTIVITIES OF ENGINEERS JOINT COUNCIL

For members of the Council and for many committeemen, the 1945 Annual Meeting began on Sunday. Reports of the actions of the Executive Committee and the Council will be found on pages 79–81 of the A.S.M.E. News Section of this issue.

On Sunday evening, in accordance with a custom of several years' standing, members of the Council and of the committees and divisions met informally to receive reports on certain activities of the Society. At this year's session the activities of the Engineers Joint Council were described. The Engineers Joint Council is made up of the officers of the Founder Societies and the American Institute of Chemical Engineers. It is the function of the Engineers Joint Council to discuss matters in which the constituent societies have common interests. Under the Council several committees have been organized, and it was to the informal reports of the activities of these committees that the Society committeemen listened on Sunday evening.

ORGANIZING THE PROFESSION

Alex D. Bailey, president A.S.M.E., and chairman of the Engineers Joint Council, presided at the Sunday evening session. The first speaker was Nevin E. Funk, fellow A.S.M.E., chairman of E. J. C. Committee on Organizing the Profession.

Mr. Funk said that he had recently taken over the chairmanship of this committee, formerly held by Harold V. Coes, past-president A.S.M.E., because of Mr. Coes' absence from the country. He reviewed the history of the formation and activities of the committee which had been organized at the suggestion of H. S. Osborne, past-president of the A.I.E.E., in 1943. It consisted of three members of each of the five participating E. J. C. Societies and its purpose was to study means of co-operation for a united front of the engineering profession. A smaller subcommittee was first set up to report on the desirability of the project. This subcommittee reported that most

D. Robert Yarnall

President of
The American Society
of
Mechanical Engineers
for 1946

of the types of organization that had been attempted had failed, and that it was apparent that to be successful an over-all organization would have to start with the "grass roots" and build up—rather than down; that co-operation in a given community must be secured first and that as this spread outward it might extend nationally.

In January, 1944, the Committee of fifteen, three from each of the participating societies in E. J. C., were appointed and Mr. Coes assumed the chairmanship. These subcommittees were set up: (1) To study the problem at the local level, with Mr. Osborne as chairman; (2) to study it at the state or regional level, with Paul T. Onderdonk, member A.S.M.E. as chairman; and (3) to study it at the national level with Major Ezra B. Whitman, past president A.S.C.E., member A.S.M.E., as chairman. A fourth Committee was originally planned to study and list existing engineering organizations, but, at the request of Mr. Coes, The Engineers' Council for Professional Development had undertaken this task. Mr. Funk reported that the E.C.P.D. had sent questionnaires to more than 300 engineering societies, organizations, and associations but that its classified list was not yet available.

The reports of the subcommittees, Mr. Funk said, were practically completed. The next step, he announced, would be to submit these reports to the Committee of Fifteen for discussion in the expectation that agreement would be reached on a recommendation to be placed before the Engineers Joint Council.

It might appear, Mr. Funk said, that the work was going slowly. It was work, however, that required time and mature deliberation and it was thought desirable to take time to do a good job. It was his opinion that eventually a good report would result for the consideration of the engineering profession.

NATIONAL RESEARCH FOUNDATION

A report on proposed national legislation in connection with the formation of the National Research Foundation was made by A. G. Christie, past-president A.S.M.E., who represented the Society on a panel appointed by the Engineers Joint Council to appear at public hearings before the Military Affairs Committee of the Senate on the Kilgore and Magnuson bills. A résumé of the statement offered by the panel at the hearing appeared on pages 787–788 of the December issue of MECHANICAL ENGINEERING.

Alex D. Bailey

Retiring President of
The American Society
of
Mechanical Engineers
for 1945

Professor Christie said that the problem of the National Research Foundation, which the Kilgore and Magnuson bills had been drafted to implement, was the most important one before engineers at the present time. Among members of the panel, he reported, there had been no differences of opinion. Boris Bakhmeteff, representative of the American Society of Civil Engineers on the E. J. C. Panel, made the presentation at the hearing. The reception accorded the Panel by Senator Kilgore was most unsatisfactory, said Professor Christie, who spoke frankly and with considerable feeling. He dwelt at length on the bad features of the Kilgore bill and urged its defeat. The Magnuson bill, on the other hand, was a satisfactory bill as originally presented on July 19, 1945.

The proposed legislation was discussed also at the Council Meeting, where Professor Christie once again presented the opinions of the Panel, and the Council voted "to go on record as opposing the Kilgore and favoring the Magnuson bill, the latter as originally presented on July 19, 1945." A summary of Professor Christie's presentation was subsequently prepared and is quoted in what follows:

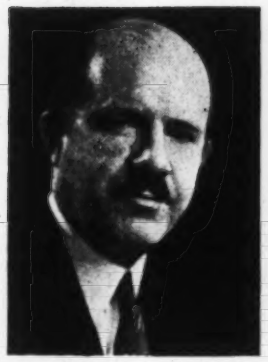
"Federal support for scientific research and education is favored. The Magnuson bill was designed to implement the plan outlined by Dr. Vannevar Bush, director of Office of Scientific Research and Development, Washington, D. C., in his report entitled 'Science, the Endless Frontier,' and this bill is approved by the advisory committees which assisted Dr. Bush. The Kilgore bill is opposed because of the political character of its control of research and of patents.

"Experience leads to the belief that responsibility for such a research program should be placed in the hands of a national science or research board composed of laymen and scientists appointed by the President without reference to political affiliation and solely on the basis of interest in and capacity to promote scientific research and education.

"It is considered unwise to subordinate the board to a single director appointed by the President as is done in the Kilgore bill. No one person, however eminent or competent could, except in a great emergency, command the confidence and support of all branches of science and of the many organizations

New Members of the 1946 A.S.M.E. Council

Regional Vice-Presidents



A. R. STEVENSON, JR.

LINN HELANDER

THOMAS S. MC EWAN

EDWARD E. WILLIAMS

RUDOLPH P. GAGG

ALTON C. CHICK

J. CALVIN BROWN

SAMUEL R. BEITLER

and agencies, private and public, whose co-operation will be required.

"The board should be responsible for the appointment and supervision of the chief administrative officer who should look after internal affairs as provided in the Magnuson bill.

"The Kilgore bill seeks to anticipate government patent policy. This should be left to the National Patent Planning Commission where it belongs."

DISARMING THE AGGRESSOR NATIONS

A report on the activities of the Engineers Joint Council in the matter of disarmament of the aggressor nations was made by R. M. Gates, past-president A.S.M.E. and a member of the E. J. C. Executive Committee.

Mr. Gates reviewed the history of these activities which began in the spring of 1944 when the so-called Morgenthau plan was being discussed. This plan, which would reduce Germany to the status of an agrarian nation, was thought by many persons to be unsound and, with the assistance of persons opposing the plan, Mr. Gates took the matter up with the engineering societies with the result that the presidents of the Founder Societies and the A.I.Ch.E. drafted a statement that became known as the "engineers' plan." This plan was released to the press in September, 1944, as noted in MECHANICAL ENGINEERING for November, 1944, pages 687–688. This report, Mr. Gates said, received favorable comment. As a result, conferences followed with the State Department and the Foreign Economic Administration and eventually with the representative of General Lucius D. Clay, deputy for General Eisenhower for U. S. Group Control Council for Germany. Further discussions resulted in the appointment of the E. J. C. National Engineers' Committee which was asked by E. J. C. in February, 1945, to make a study and to suggest measures for postwar control of German war potential. This request was supplemented by the approval of the State and War Departments. The study was made by 35 leading engineers and technologists and the report, after transmission to authorities in Washington, was made public on Sept. 26, 1945. A résumé of it appeared in MECHANICAL ENGINEERING, November, 1945, pages 754–756.

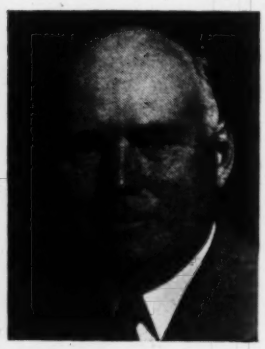
Mr. Gates, after reading the general conclusions of the report, stated that General Clay had asked the committee's aid in selecting a technical staff of 350 high-grade engineers to go to Europe in connection with matters with which the report dealt. He read excerpts of letters from War Department and State Department officials expressing appreciation of the report and asking aid in the event it should be needed in the industrial disarmament of Japan.

Mr. Gates closed his comments by stating that he was very proud of the fact that the signatures of five engineering-society presidents had been secured for the original 1944 document.

New Members of the 1946 A.S.M.E. Council

Directors-at-Large

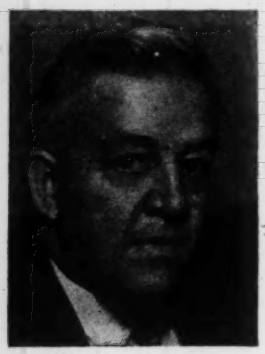
DAVID LARKIN



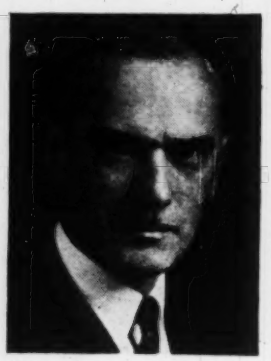
JOHN E. LOVELY

EDGAR J. KATES

J. N. LANDIS



JAMES M. ROBERT



SAMUEL H. GRAF

DANIEL S. ELLIS

A. J. KERR

ECONOMIC STATUS OF THE ENGINEER

The concluding discussion of the Sunday evening meeting was a progress report by I. M. Stein, member A.S.M.E., chairman of the E. J. C. Committee on the Economic Status of the Engineer.

Mr. Stein stated that the work of this committee had started two years ago and that its recommendations were advisory. Activities, he said, were being conducted by three survey committees.

The first of these committees, under the chairmanship of E. G. Bailey, fellow A.S.M.E., was inquiring into employer practices regarding engineering graduates. The survey, to be made in the industries, would be conducted by sending out about 2000 questionnaires following a pilot survey to 200 firms. In his opinion, the survey would have an importance that would transcend that of the statistics collected because, in preparing answers to the questionnaire, the employer would be forced to think about his present practices. No salary data would be collected by this questionnaire.

The second committee, under the chairmanship of Col. W. N. Carey, secretary, A.S.C.E., was to undertake a study of the salaries of graduate engineers. Previous studies of engineers' salaries made by several engineering societies were out of date, Mr. Stein said. It had been hoped that the Bureau of Labor Statistics would be able to make this study but this plan had fallen through and hence the study would have to be made by the committee. Mr. Stein estimated that the cost of securing salary data from 100,000 engineers would amount to at least $25,000.

The third committee, under the chairmanship of E. P. Yerkes, of Philadelphia, Pa., was engaged in a study of collective bargaining by engineers and sought to secure the viewpoint of employee engineers. A tentative report of the A.I.E.E. had been published to acquaint engineers with the problem.

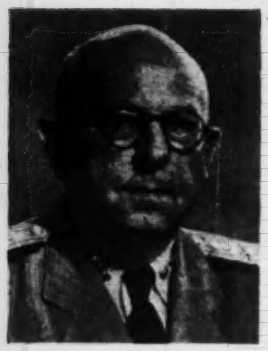
ANNUAL DINNER

The 1945 Annual Dinner for Members and the A.S.M.E. Honors Night took place in the Grand Ballroom of the Astor Hotel, New York, N. Y., on Tuesday evening, November 26. In spite of the unfortunate changes in time and plan, members came in great numbers and in excellent spirits, to pay tribute to engineering achievement and to enjoy a few hours of social relaxation. The attendance of 1415 filled the main floor and a considerable portion of the first balcony.

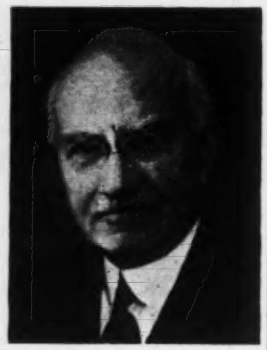
After the dinner Alex D. Bailey, retiring president, stepped up to the rostrum on the dais and began the after-dinner ceremonies by introducing Paul Parks, professional singer, who, accompanied by Lester M. Leet, member A.S.M.E., at the organ, sang "The Star-Spangled Banner." The names of the new "Fifty-Year Members of A.S.M.E." were read, followed by the conferring of honors and awards and the main address of the

As Seen by the Candid Camera at the 1945 A.S.M.E Annual Dinner

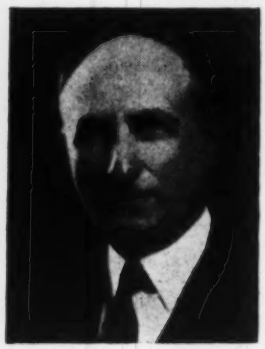
Made Honorary Members of the A.S.M.E.



HAROLD G. BOWEN
Honorary Membership



DUGALD CALEB JACKSON
Honorary Membership



ANDREY A. POTTER
Honorary Membership

WONG WEN-HAO
Honorary Membership

evening, which was given by Lieutenant General Ira C. Eaker, U. S. Army, Deputy Commander, Army Air Forces, who spoke on "Victory Through Air Power." The complete text of this address will be found on pages 5–6 of this issue. From the ballroom, guests were asked to retire to the Rose Room where the President's reception was held. Music for the dancing which followed was provided by Eddie Worth and his orchestra.

50-YEAR MEMBERS

Of the 17 A.S.M.E. members who celebrated their 50th anniversary of Society membership in 1945, only four were present on this occasion to accept the 50-year gold buttons. They were Fred H. Colvin, John W. Gray, Arthur M. Greene, Jr., and Arthur Louis Rice. The other 50-year members who could not be present but who will receive their buttons at some other time were: J. Francis Booraem, George W. Colles, William S. Conant, Edward Richard Gnade, Frederick A. Goetze, George F. Hardy, Albert C. Larkin, Peder Lobben, William E. Mathews, John A. Pilcher, A. M. Robeson, George B. Wilcox, and Howard E. Williams.

THE 1945 MEDALISTS

In conferring the honors and awards, the two marshals, L. W. Wallace and Eugene W. O'Brien, conducted the candidates to the center of the dais where Carl L. Bausch, chairman, Board of Honors and Awards, read the citations. The awards were presented by President Bailey.

The following awards were presented:

A.S.M.E. Medal to William Frederick Durand "for his contributions in hydrodynamic and aerodynamic science and its practical application; for his inspiring character and his unique capacity for lucidity and simplicity in imparting highly technical material; for his trustworthy advice to our Government in the solution of many intricate scientific problems in peace and during two world wars."

Holley Medal to Sanford A. Moss "for his many contributions to the development and application of turbosuperchargers to internal-combustion engines."

Worcester Reed Warner Medal to Joseph M. Juran "for his outstanding contributions to the problem of quality control in mass production and his splendid records of such work as are contained in his books 'Bureaucracy, a Challenge to Better Management,' and 'Management of Inspection and Quality Control.'"

Melville Medal to William Julian King "for his paper 'The Unwritten Laws of Engineering.'"

Junior Award to Bruce Eugene Del Mar "for his paper, 'Presentation of Centrifugal-Compressor Performance in Terms of Nondimensional Relationships.'"

Honorary Membership to Rear Admiral Harold G. Bowen, with the citation: "Very few, indeed, can hope to win the dignity of personality and reputation that Admiral Harold G. Bowen has won, but the least accomplished among us can cultivate something of the satisfaction that he finds undiminished as an outstanding gentleman and engineer of solid achievements in a long life of distinguished service for his country and the safeguarding of a better world in which to live."

Honorary membership to Dugald Caleb Jackson "for his leadership and understanding as a teacher and for his lofty and unselfish application to his calling."

Honorary membership to Andrey Abraham Potter "for leadership in adjusting engineering education to the needs of the war training as chairman of the committee guarding the U. S. Office of Education program known as Engineering Science and Management War Training."

Honorary membership to Wong Wen-hao "for the extraordinary contributions he has made to public service since he symbolizes the ideal public administrator, highly trained, imaginative, and courageously disinterested." The certificate of honorary membership was received by W. C. Chang, technical expert, National Resources Commission of China.

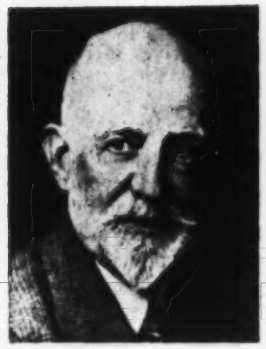
Mr. Bailey announced that a certificate of honorary membership had been given to Sir William Stanier at Ottawa on Sept. 28, 1944, during the A.B.C. Conference on Screw Threads, which Sir William attended.

THE PRESIDENTS SPEAK

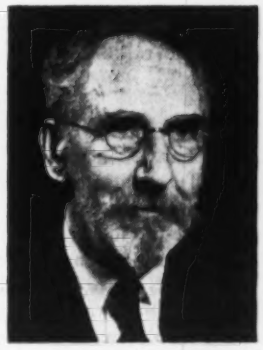
Departing from the customary practice of presenting a written address, Mr. Bailey reviewed some of the accomplishments of the Society during his administration. He introduced D. Robert Yarnall, president-elect, who spoke briefly. Mr. Yarnall said:

"Another A.S.M.E. year has passed; as a result of this Annual Meeting a new administration is being installed. As we take office, we want to thank the outgoing administration for

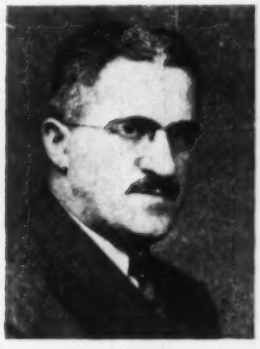
Recipients of Medals and Awards



WILLIAM F. DURAND
A.S.M.E. Medal



SANFORD A. MOSS
Holley Medal



JOSEPH M. JURAN
Warner Medal

WILLIAM J. KING
Melville Medal

JACK DRANDELL
Charles T. Main Award

BRUCE E. DEL MAR
Junior Award

JOHN W. ERICKSON
Undergraduate Award

the splendid way in which it has managed the affairs of the Society, as evidenced by the record we find.

"Ours is a great profession and our Society, now with almost 20,000 members, 17 divisions, 70 sections, and 120 student branches, is a most important group in this great profession. Largely because of our size, we have now changed our Society's structure by the election of eight regional vice-presidents, seven of whom are here tonight, whose duty it shall be to keep in very close touch with the sections and student branches and professional activities in their districts. It will be our firm policy in the coming year to support and help these vice-presidents.

"Now that the war is over, ours will be the first full year of reconstruction—of reconversion. Engineers are always expected by their countrymen to carry a full share of the load in national crises. We know that now the country can count on these same engineers with equal confidence, not only to "beat swords into ploughshares and spears into pruning hooks," but to help insure, through their sense of citizenship responsibility, that, to use Lincoln's famous words, "this nation, under God, shall have a new birth of freedom" and that "government of the people, by the people, for the people shall not perish from the earth."

"Let us move forward into these years of peacemaking as engineers and as good citizens in response to this high calling.

"Your new administration pledges itself to maintain the high standards which have always been the background of our Society's work and which have been so ably maintained by our predecessors, and particularly in the past year by President Bailey and his associates. We trust your confidence in us will be justified."

At the conclusion of Mr. Yarnall's brief address, President Bailey introduced the newly elected vice-presidents and directors at large.

LUNCHEONS AND DINNERS

In addition to the Annual Dinner on Tuesday evening, Annual Meeting week afforded opportunity for numerous public luncheons and dinners, in addition to a number of luncheons and dinners of committees and small groups brought together by special common interests for the conduct of their business.

TRAINING FOR LEADERSHIP

The opening general luncheon was held on Monday noon under the auspices of the Committee on Education and Training for the Industries and the Management Division. President Bailey presided and the speaker was General Jacob L. Devers, Commanding General, Army Ground Forces, Washington, D. C. General Devers was introduced by his West Point classmate, Col. James L. Walsh, member A.S.M.E., who has been active in A.S.M.E. national defense activities ever since the close of World War I. The title of General Devers' address was, "Training for Leadership." The address will be found elsewhere in this issue.

OFFICERS OF THE A.S.M.E.
(*Left to right:* Alex D. Bailey, President, 1945; C. E. Davies, Secretary; D. Robert Yarnall, President, 1946.)

Following the luncheon a session devoted to the subject of training for leadership, at which Colonel Walsh presided, attracted a large audience. The speakers were Brigadier General H. R. Kutz, member A.S.M.E., Chief Military Training Service, Office of Chief of Ordnance, U. S. Army, Washington, D. C.; Rear Admiral James L. Holloway, Jr., U. S. Navy, Assistant Chief, Navy Personnel for Demobilization, Navy Department, Washington, D. C.; Sam A. Lewisohn, mining banker and author, of New York, N. Y.; and D. C. Prince, vice-president, General Electric Company, Schenectady, N. Y.

ROCKET DINNER

The Rocket Dinner, held Monday evening in the Penn Top Room, under the auspices of the Aviation and Oil and Gas Power Divisions, marked the first meeting of the American Rocket Society and The American Society of Mechanical Engineers since the affiliation of the two societies.

G. Edward Pendray, secretary of the American Rocket Society, spoke on the basic concepts of the rocket. Some of the more technical aspects of the rocket motor were explained by Lovell Lawrence, Jr., president, Reaction Motors, Inc., Pompton Plains, N. J., who presented a paper, "The Liquid-Propellant Rocket Motor."

WOOD INDUSTRIES DINNER SILVER ANNIVERSARY

The 25th Anniversary Dinner of the Wood Industries Division was held on Monday evening at the Hotel Astor. Serving as toastmaster for the occasion was P. H. Bilhuber, associate A.S.M.E., vice-president and director, Steinway Piano Company, New York, N. Y.

After dinner and before the evening session was called to order a symposium was held on "Wood and Its Utilization." C. L. Babcock, member A.S.M.E., Babcock Machinery Corporation, New York, N. Y., spoke on the outlook of woodworking machinery. He was followed by Paul Kennedy, member A.S.M.E., Murphy Finishes Corporation, Newark, N. J., who spoke briefly on the matter of wood finishes. T. D. Perry, member A.S.M.E., Resinous Product and Chemical Company, Philadelphia, Pa., who was the third speaker, talked on "The Outlook of Adhesives," and "The Outlook of Wood Furniture" was sketched by C. B. Lundstrom, member A.S.M.E., Standard Furniture Company, Herkimer, N. Y.

Other speakers taking part in the symposium were F. J. Hanrahan, member A.S.M.E., American Lumber Manufacturers Association, Washington, D. C., who spoke on "Better Uses of Forest Materials," and John Willard, member A.S.M.E., Bigelow, Kent, Willard and Company, Boston, Mass., who talked on "Production Incentives in the Wood Industries."

MANAGEMENT LUNCHEON

More than 200 members attended the Management Luncheon held on Tuesday in the Penn Top Room. The keynote of the meeting was sounded by Reginald E. Gillmor, member A.S.M.E., vice-president, Sperry Corporation, who used as his subject "Management Opportunities in Peacetime." The full text of Mr. Gillmor's remarks is published on pages 14–16 of this issue.

L. A. Appley, retiring chairman of the Management Division, was presented with a Certificate of Award by Andrew I. Peterson, chairman of the Division for 1946. The certificate is a token of appreciation given by the Society to retiring chairmen of certain committees.

NATIONAL RESEARCH GENERAL LUNCHEON

President Bailey presided at the National Research General luncheon held on Tuesday noon at the Hotel Pennsylvania. At this luncheon were student members of the Society and presentations were made of the Charles T. Main Award and the Undergraduate Student Award. A report of this feature will be found in the A.S.M.E. News Section of this issue.

The speaker at the luncheon was Laurence A. Hawkins, formerly executive director, Research Laboratory, General Electric Company, New York, N. Y. His address, "The Problems We Face" dealt with the need for a national research program and some features of Senate bills introduced into the Congress to implement a research program. Mr. Hawkins' address is published in this issue, pages 11–13.

At the session on Research for National Security which followed the luncheon, President-Elect D. Robert Yarnall presided. The speakers were William F. Durand, past-president and honorary member A.S.M.E.; Rear Admiral Harold G. Bowen, honorary member A.S.M.E.; Major General G. M.

MEDALISTS HONORED AT 1945 A.S.M.E. ANNUAL MEETING
(*Left to right:* Bruce E. Del Mar, Junior Award; Joseph M. Juran, Warner Medal; Sanford A. Moss, Holley Medal; William J. King, Melville Medal; William F. Durand, A.S.M.E. Medal.)

Barnes, member A.S.M.E., Director of Research and Development, Ordnance Department, Washington, D. C.; Major General B. W. Chidlaw, Deputy Commander, Engineering, Wright Field, Dayton, Ohio; and Col. William H. McLean, assistant to Brigadier General Georges Doriot, member A.S.M.E., Director of Military Planning Division, Office of the Quartermaster General, U. S. Army, Washington, D. C.

APPLIED MECHANICS DINNER

The Applied Mechanics Division held its annual meeting on Wednesday evening in the Penn Top Room. Dr. C. C. Furnas, director of research, Airplane Division, Curtiss-Wright Corporation, Buffalo, N. Y., delivered the address of the evening, speaking on the future trends of aviation.

Dr. Furnas gave the 150 guests in attendance a comprehensive review of his study of future trends in air travel. He predicted a great advance in frequency of air travel service, 99 per cent reliability in contrast to the 91 per cent prevalent today, and top travel speeds in the range of 300 miles per hour. His talk was characterized by optimism in the face of recent studies which indicated steep declines in aircraft manufacture.

SILVER ANNIVERSARY LUNCHEON OF MATERIALS HANDLING DIVISION

The 25th anniversary of the Materials Handling Division was commemorated at a luncheon held in the Gold Room of the Hotel Martinique on Thursday.

James A. Jackson, chairman of the Division, who presided at the luncheon, began the brief ceremony by introducing the man who first served as chairman of the Division, Robert M. Gates, past-president A.S.M.E., president, Air Products Corporation, New York, N. Y.

Mr. Gates spoke briefly about the early days of the Division and the significant contributions it has made to the affairs of the Society over the past two and one half decades.

Brigadier General Selby Frank, Chief of Supply Control Office, Chief of Ordnance, U. S. Army, the main speaker of the luncheon, was introduced by Mr. Gates.

General Frank spoke on "Victory on Wheels," and said that "the days when an Army was supposed to move entirely on its stomach went with the limbo of forgotten things with this war. Today and henceforward, an army moves on wheels."

TEXTILE LUNCHEON

Sandwiched in between two interesting technical sessions, the Textile luncheon, held on Thursday, was a refreshing pause for the 35 guests in attendance.

In view of the fact that the luncheon was held in the same room as the sessions and that all guests had listened to the morning papers and discussions, there was no special program at the luncheon.

IN THE GEORGIAN ROOM AT THE 1945 ANNUAL MEETING (*Left to right:* R. Tom Sawyer, Hans Gygi, Curt Keller, and L. N. Rowley.)

ALEX D. BAILEY (LEFT) CONGRATULATES DR. W. F. DURAND, A.S.M.E. MEDALIST

RAILROAD LUNCHEON

The annual Railroad Division Luncheon was held on Thursday at the Pennsylvania Hotel. Six hundred members and guests representing a cross section of the railroad industry were present. The luncheon was in charge of E. D. Campbell, member A.S.M.E., vice-president in charge of engineering, American Car and Foundry Company, New York, N. Y.

The high point of the luncheon was the presentation of certificates representing election to the grade of fellow member A.S.M.E. to six members of the Railroad Division. On this occasion W. M. Sheehan, retiring chairman of the Railroad Division, introduced President Bailey, who spoke briefly and presented the certificates to the following: Charles Edward Brinley, Jos. B. Ennis, Paul W. Keefer, Charles T. Ripley, and Karl F. Nystrom. William C. Dickerman, who was also to receive a certificate, was unable to be present.

Karl F. Nystrom will be chairman of the Railroad Division for 1946.

SILVER ANNIVERSARY AVIATION DINNER

The third silver anniversary celebration of the 1945 Annual Meeting was held by the Aviation Division at its annual dinner, Thursday evening in the Penn Top Room. Toastmaster on this occasion was Rear Admiral Luis de Florez, U.S.N.R., member A.S.M.E.

While introducing the first speaker, W. A. M. Burden, assistant secretary of Commerce, Admiral de Florez set the tone of the evening when he said that the air has been conquered and that it was the task of this generation to put the air to work.

Mr. Burden spoke on the "Future of Flying" and predicted great strides in the use of personal aircraft.

The second speaker, Arthur I. Boreman of Des Moines, Iowa, predicted that the advance of private flying would proceed at such a rate that within two years six out of every ten people at the dinner would be flying planes.

With the showing of the film "Flivver Flying" on the heels of the promising statements of the speakers, most of the guests were definitely placed in the camp of the air enthusiasts.

PETROLEUM DINNER

The Keystone Room of the Hotel Pennsylvania was the scene of the Petroleum Dinner held Thursday evening. Mr. William Raisch, chairman of the Petroleum Committee, presided at the dinner and introduced Robert E. Allen, director, Department of Information, American Petroleum Institute, New York, N. Y., who addressed the guests on the "American Petroleum Institute—Its Purposes and Activities."

Mr. Allen described the American Petroleum Institute as a trade association whose principal duties were to the public. While it has undertaken many technical projects, the Institute had conducted programs concerned only with particular problems of the Petroleum industry which did not come within the jurisdiction of the technical engineering societies. He spoke of the tremendous amount of work still to be done and invited the co-operation of The American Society of Mechanical Engineers in petroleum problems of a mechanical nature.

Mr. Raisch thanked Mr. Allen for his informative talk and assured him that the Society was willing and organized to take up its part of the burden of petroleum problems and to co-operate fully, as it had done in the past, with members of the American Petroleum Institute.

TECHNICAL SESSIONS

So extensive was the program of technical sessions at the 1945 A.S.M.E. Annual Meeting that space even to list the papers presented and give credit to the divisions and technical committees which provided them and the chairmen who officiated would be beyond the realms of the possibilities under present conditions. An earnest attempt was made to provide in one form or another preprints of as many papers as were received in time to be put through the editorial and printing procedures. More than 60 preprints were made available for distribution at the meeting. As the publication schedules of MECHANICAL ENGINEERING, A.S.M.E. Transactions, and the *Journal of Applied Mechanics* permit, many of these papers will be printed with the discussions they occasioned. Some have already appeared and others will be published in early issues.

TECHNICAL COMMITTEE PARTICIPATION

In addition to co-operating with the professional divisions in the planning for and carrying through of seven technical sessions, the four A.S.M.E. technical committee groups held 53 technical-committee meetings and conferences.

STANDING COMMITTEE MEETINGS

During the week the four standing committees, which direct the technical-committee activity, held their annual meetings. The A.S.M.E. Standardization Committee, W. H. Hill, chairman, held its meeting on Monday afternoon. The A.S.M.E. Safety Committee, H. W. Gabor, vice-chairman, came next with a meeting on Tuesday morning. The A.S.M.E. Research Committee, W. R. Elsey, chairman, followed with its meeting on Thursday afternoon, and the A.S.M.E. Power Test Codes Committee, A. G. Christie, chairman, met after the official close of the Annual Meeting with its meeting on Friday morning. All of these meetings of standing committees were well attended.

RESEARCH GROUP

Beginning with a luncheon meeting on Monday noon, the research group scheduled 17 meetings of special and joint research committees. In most cases the business of these meetings had to do with the reports of researches in progress, discussions of technical questions raised by the studies, and plans for new investigations. A list of the committee meetings held is given below. A total of 140 persons attended these meetings.

Plastic Flow of Metals, A. Nadai, chairman.
Critical Pressure Steam Boilers, H. L. Solberg, chairman.
Mechanical Springs, J. R. Townsend, chairman.
Lubrication, B. L. Newkirk, chairman.
Cutting Fluids, O. W. Boston, chairman.
Fluid Meters, R. J. S. Pigott, chairman.
Metal Cutting Data and Bibliography, M. Martellotti, chairman.
Internal-Combustion Engines, Lee Schneitter, chairman.
Strength of Vessels Under External Pressure, F. V. Hartman, chairman.
Effect of Temperature on the Properties of Metals, N. L. Mochel, chairman.
Standing Committee on Research, W. R. Elsey, chairman.
Furnace Performance Factors, A. R. Mumford, chairman.
Automatic Regulation Theory, C. E. Mason, chairman.

STANDARDS GROUP

The standards group of technical committees held a total of 25 meetings during the week. All of them were exceptionally well attended. Two of these, namely, the meetings of the Technical Committee on Carbide-Tipped Milling Cutter Bodies, No. 24 of B5, and the Subcommittee on Standard Surface Roughness Blocks, B46, were organization meetings. The following is a list of the standards committees which held meetings during the week with a total attendance of 288:

Therbligs, Process Charts, and Their Symbols, D. B. Porter, chairman.
Standing Committee on Standardization, W. H. Hill, chairman.
Screw Threads, B1, E. J. Bryant, chairman.
Working Ranges of Machine Tools, B5, John Haydock, chairman.
Nomenclature of Small Tools, B5, O. W. Boston, chairman.
Carbide-Tipped Milling Cutter Bodies, B5, H. B. Lewis, chairman.
General Conference on International Standardization of Screw Threads, E. J. Bryant, chairman.
Design and Dimensioning of Drawings With Tolerances and Allowances, Z14, H. L. Keller, chairman.
Plain and Lock Washers, Sectional and Subcommittees, B27, W. L. Barth, chairman.
Straight-Sided Splines, B5, J. B. Armitage, chairman.
Forming Tools and Holders, B5, W. C. Mueller, chairman.
Standard Surface-Roughness Blocks, B46, H. J. Griffing, temporary chairman.
Scope and Intent—Pressure Piping, B31, Sabin Crocker, chairman.
Punch Press Tools, B5, C. D. Carter, chairman.
Spindle Noses, B5, J. E. Lovely, chairman.
Conference on Standardization of Connections for Engine Pressure Indicators, C. P. Bliss, chairman.
Small Tools and Machine-Tool Elements, B5, W. C. Mueller, chairman.

THE PRESIDENT'S RECEPTION WITH MRS. LILLIAN M. GILBRETH (LEFT) ABOUT TO SHAKE HANDS WITH MRS. YARNALL AS THE PRESIDENT-ELECT LOOKS ON

ARTHUR LOUIS RICE, "FIFTY-YEAR MEMBER OF A.S.M.E.," AND WILLIAM PHILLIPS CAINE, NEARING "FIFTY-YEAR MARK," REMINISCE AT THE MEETING

PRESIDENT D. ROBERT YARNALL (LEFT) WITH LIEUTENANT GENERAL IRA C. EAKER, SPEAKER AT THE DINNER

ERNEST HARTFORD, EXECUTIVE ASSISTANT SECRETARY OF THE A.S.M.E., TALKS IT OVER WITH PRESIDENT ALEX D. BAILEY

MEMBERS OF THE BELGIAN ECONOMIC MISSION IN ATTENDANCE AT THE 1945 ANNUAL MEETING
(R. Malengret Lebrun and Albert Jadot.)

A.S.A. War Committee on Rating Pipe Flanges, B16, N. O. Smith-Petersen, chairman.

B16, A.S.A. War Committee Subgroup of Subcommittees Nos. 3 and 4 on Rating Pipe Flanges, N. O. Smith-Petersen, chairman.

American Standard Plumbing Code Subgroup, A40, A. H. Morgan, chairman.

Informal Conference on Limits and Fits for Engineering and Manufacturing, B4, J. E. Lovely, chairman.

SAFETY GROUP

Owing to the fact that only one of the safety codes for which the Society is sponsor is under revision at this time, this group did not schedule a series of committee meetings this year. The standing committee, however, held a successful meeting as stated on Tuesday morning.

POWER TEST CODES GROUP

There were ten technical committee meetings of the Power Test Codes group scheduled during the Annual Meeting week. The business transacted at these meetings was largely of a routine nature and had to do primarily with the completion of the revisions of test codes now available in pamphlet form. A list of the names of these committees with the names of their chairmen follows.

Fuels, R. A. Sherman, chairman.

Compressors and Exhausters Working Committee, Arvid Peterson, chairman.

Hydraulic Prime Movers, S. Logan Kerr, chairman.

Stationary Steam-Generating Units Working Committee, M. W. Benjamin, chairman.

Speed Governing of Hydroelectric Units, Herbert Estrada, chairman.

Internal-Combustion Engines, Lee Schneitter, chairman.

Specifications for Speed Governing, M. J. Steinberg, chairman.

Standing Committee on Power Test Codes, A. G. Christie, chairman.

VISIT TO SUPERSONIC WIND TUNNEL AT ABERDEEN

Following the 1945 A.S.M.E. Annual Meeting, a group of approximately fifty members visited the Ordnance Supersonic Wind Tunnel[1] at Aberdeen, Md., on Friday, November 29. The trip was sponsored jointly by the Aviation and Applied Mechanics Divisions.

After a brief description of the bomb tunnel by Ordnance personnel, the visitors had a chance to see the tunnel in operation. On the viewing screen of a Schlieren camera, the group could actually observe the pattern of air flow around the test model, which was suspended on a delicate balance system. By transmitting the forces acting on the balance unit to dials, the drag, lift, and pitching moment can be registered directly in standard units. The bomb tunnel is used primarily for the study of finned projectiles. An article in the December, 1945, issue of MECHANICAL ENGINEERING, pages 827–833, described the general features of the tunnel.

Next, the compressor room containing the power plant was visited. This consists of five centrifugal compressor units, operating in parallel or in series, up to three stages of compression. A total of 13,000 hp is available.

The visitors also got a preview of the new ballistic tunnel which awaits the completion of a flexible nozzle and balance system and is therefore not in operation as yet. This tunnel, when completed, will handle models of any kind, spinning, finned, or winged, within the limits of the test section.

Dr. T. L. Smith then gave a talk on the design of the new balance unit for the ballistic tunnel. Luncheon was served at the Officers' Club.

After luncheon Colonel Leslie E. Simon, director of the Ballistic Research Laboratory, emphasized the fact that the research and development program should continue in the post-war period just as it did during the war years.

In the afternoon the group inspected the aerodynamics range and a mobile unit containing multiple channel cathode-ray recording oscillographs.

A paper on "Aerodynamics Range" was then presented by A. C. Charters, followed by a paper and demonstration on ballistic measurements by Thomas L. Johnson.

INDUSTRIAL FILMS

Three industrial films were shown on two occasions during the Annual Meeting. Each of the showings was attended by approximately 50 engineers. One visitor, after viewing the films, said, "This is possibly the best method of instruction and dissemination of valuable information. Such timely subjects as visits to plants, product, and process procedures can be conveniently brought to the attention of engineers."

Valuable suggestions were offered by other members. In general the films were favorably received, not as substitutes for plant visits, which members considered of prime value, but as supplementary programs for those who cannot devote time away from technical sessions. Showing of the films continuously between the main programs and technical sessions was suggested as a way of making the films available without competing with the principal features of an Annual Meeting.

PLANT TRIPS

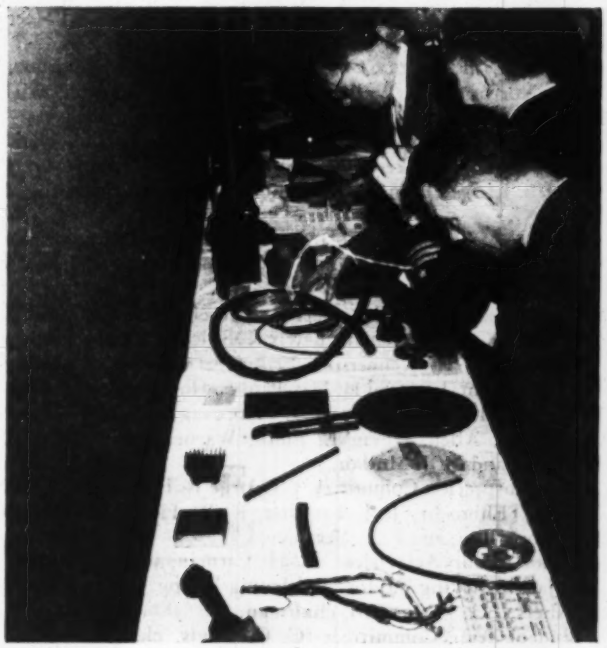
On Monday the Anderson Aircraft Incorporated played host to members in attendance at the Annual Meeting, who were given the opportunity to see in operation a machine which forms compound curved panels or sheet metal without any dies and a display of the samples of the machine's work.

A special bus took another party of members on a 2½-hour tour of the Queens Midtown Tunnel on Tuesday afternoon. Beginning with the control room from which all signals, lights, fans, and services are controlled, the tour continued to the repair shops, service garage, ventilation tower, and the pump room. The feature of the visit was the catwalk from which the ventilating ducts, lighting, drainage, and control systems could be viewed. Mr. Clemens F. Holm, superintendent, was the host for the afternoon.

The most popular trip by far of the 1945 Annual Meeting was the visit to the Brooklyn Navy Yard, the largest Navy Yard in the country, where Rear Admiral F. A. Daubin, Commandant of the Yard, was host to 240 A.S.M.E. members on Wednesday afternoon. Admiral Daubin provided busses and a detail of young officers to guide the engineers about the Yard. The U.S.S. *Missouri*, with her plaque of triumph marking the spot of the Tokyo surrender, was the high spot of the trip.

A sizable group took advantage of the invitation of the Tech-Art Plastics Company to inspect on Thursday afternoon a modern and extensive plant fabricating parts from plastics by compression-injection and transfer molding. Dr. Roy Berg was the host during this trip.

[1] For a detailed description of the Supersonic Wind Tunnel, refer to Major General G. M. Barnes's article on page 827 of the December, 1945, issue of MECHANICAL ENGINEERING.



SPECTATORS GET AN EYEFUL OF NEW MATERIALS AND PRODUCTS AT ONE OF THE RUBBER AND PLASTICS SESSIONS

J. E. YOUNGER, SECRETARY OF AVIATION DIVISION, A. G. CHRISTIE, PAST-PRESIDENT OF A.S.M.E., AND D. ROBERT YARNALL, NEW PRESIDENT OF THE SOCIETY, ENJOY CHAT AFTER THE JOINT COUNCIL MEETING

REAR ADMIRAL H. S. BOWEN, HONORARY MEMBER A.S.M.E., MAJOR GENERAL B. W. CHIDLAW, AND MAJOR GENERAL G. M. BARNES, MEMBER A.S.M.E., TAKE TIME OUT TO BE PHOTOGRAPHED

LIONEL S. MARKS, C. H. BERRY, E. S. PLEASONTON, AND R. BURDETTE DALE APPEAR HAPPY ABOUT THE WHOLE THING

B. V. E. NORDBERG, L. N. ROWLEY, JR., AND EDWIN F. CHURCH ENGROSSED IN CONVERSATION

COLLEGE REUNIONS

The annual meeting is a time of reunions. This year the Harvard Engineering Society gathered in the North and Biddle Rooms of the Harvard Club on Thursday evening for a buffet dinner, after which the members attended the Society-sponsored technical session, "The Crossing of the Rhine," in the Manhattan Room of the Hotel Pennsylvania, at which Brigadier General P. H. Timothy described the largest operation of its kind in military history. Similarly, the Cornell Alumni after a buffet supper at the Cornell Club, boarded busses and attended the same technical session where seats had been reserved for them.

Rensselaer Alumni Association held a luncheon on Thursday and the Purdue Club of New York City arranged a reunion dinner for Friday.

The Worcester Polytechnic Institute alumni used the occasion to bring together the Northern New Jersey and New York Chapters at the Yale Club to hear Rear Admiral (Rtd) Watts T. Cluberius, president of W.P.I., speak generally about the affairs of the Institute.

New York University extended an open hand to all alumni at the Department of Mechanical Engineering rooms at University Heights on Thursday, while the Clarkson Tech. Alumni Association chose Friday evening at the Building Trades Employers' Association for their reunion.

COMMITTEES IN CHARGE

Meetings of The American Society of Mechanical Engineers come under the general supervision of the Committee on Meetings and Program. The technical program is provided by the Society's professional divisions and technical committees. Other features are planned and supervised by committees organized within the Metropolitan Section. In grateful acknowledgment of the many committees whose efforts contributed so substantially to the success of the 1945 Annual Meeting their personnel is listed in what follows:

Meetings and Program Committee: F. G. Surtzer, chairman, R. A. North, D. S. Walker, and Paul W. Thompson, with Irving Taylor and Chas. H. Chapman, Jr., as junior advisors.

Committee on Dinners and Honors: W. H. Larkin, chairman, J. H. Sengstaken, vice-chairman, S. H. Libby, G. J. Nicastro, R. W. Flynn, L. B. Schuler, and Mrs. F. M. Gibson, Jr.

Board of Honors and Awards: Carl L. Bausch, chairman, L. W. Wallace, Roy C. Muir, E. W. O'Brien, and Charles M. Allen.

Committee on Medals: Carl L. Bausch, chairman, Joseph W. Barker, Clarke Freeman, Lewis K. Sillcox, Ely C. Hutchinson, William H. Kennerson, Erik Oberg, L. W. Wallace, Fred H. Colvin, Lawford H. Fry, Paul E. Holden, Roy C. Muir, Frederick M. Feiker, Ernest L. Hopping, E. W. O'Brien, Charles M. Allen, Nevin E. Funk, Warner Seely, Blake R. Van Leer, and M. J. Mullan.

Plant Inspection Committee: George E. Hagemann, chairman, A. Ehbrecht, J. J. Fetscher, R. W. Flynn, C. O. Herb, J. J. Morro-Lin, and F. L. Yerzley.

Junior Group Activities: C. H. Carman, junior chairman, J. J. Jacobs, Irving Taylor, and Irving West.

Ushers: G. J. Nicastro, chairman.

Student Aide Committee: C. C. Davis, chairman, H. E. Church, K. E. Quier, K. J. Moser, S. J. Tracy, F. L. Singer, W. A. Vopat, H. E. Walter.

Women's Events Committee: Mrs. J. N. Landis, honorary chairman, Mrs. Earl B. Smith, general chairman, Mrs. Waldo McKee, general vice-chairman; Mrs. A. W. Anderson (Registration), Mrs. Collins P. Bliss and Mrs. A. R. Cullimore (Annual Luncheon), Mrs. F. M. Farmer (Monday Tea), Mrs. H. R. Kessler and Mrs. F. M. Gibson (Activities), Mrs. C. H. Kent (Publicity and Printing), Miss Jo-Anne Wright, Miss Dorothy Field, and Mrs. F. M. Gibson, Jr. ("AsKme").

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Freight-Car-Truck Development

COMMENT BY DONALD S. BARROWS[1]

Mr. Cottrell's paper[2] covers the subject of freight-car design and testing comprehensively. In his sixth fundamental of freight-car-truck design, he states that the swing-motion method of absorbing lateral forces is not, in his opinion, necessary. The writer is inclined to agree with that specific statement but feels that "other means" may be necessary for high speeds, and the prevention of lading damage from lateral shocks.

As to his eighth fundamental, the matter of separate journal boxes should not be decided primarily on the basis of first cost. If it should be found that means for absorbing lateral shocks should preferably be near the point of origin, rather than at the bolster, the separate box would permit this while the box cast integral with the side frame would not. It has not yet been settled that spring mounting at the journal boxes is not worth while. It undoubtedly reduces the amount of unsprung weight and should cause a quicker follow-up of the individual wheels when striking low spots in the track. It is clear that if service requirements or reduced maintenance should require roller bearings, then separate boxes would be necessary not only to avoid the undue expense of machining the side frames but to insure automatic alignment for roller bearings not spherically mounted.

In his tenth fundamental, Mr. Cottrell does not mention a matter temporarily deferred by the present war, which is the possible desirability of side bearings maintaining constant contact and having a certain amount of resiliency in themselves to minimize truck shimmy and car-body roll, nor does he mention in the twelfth fundamental that the use of elliptical springs properly placed in the suspension system automatically breaks up synchronism of the helical coils and makes unnecessary and perhaps costs less than other equally effective means of controlling vertical spring action.

Mr. Cottrell's paper is a valuable contribution at a critical stage in a determined effort by some of the truck manufacturers and the A.A.R. to settle many long-pending questions and if possible to arrive at a high speed standard based on over-all performance rather than on first cost alone.

AUTHOR'S CLOSURE

It is indeed gratifying that one so well versed in the design of freight-car trucks as Mr. Barrows, is so generally in agreement with the views expressed by the author.

Concerning his remarks in connection with the sixth fundamental, it was not the intention to create the impression that some form of control for lateral shocks was not necessary. I believe it has been thoroughly demonstrated that "other means" incorporating resilient or frictional control are a satisfactory substitute for "swing motion" and of course are considerably less expensive.

I agree with Mr. Barrows when he states that the matter of separate journal boxes should not be decided primarily on the basis of first cost. However, I believe this is an important consideration, particularly since it has been shown by actual tests that the use of separate journal boxes is not necessary to produce excellent riding qualities and safe performance in freight-car trucks.

Mr. Barrows mentions the possible use of constant-contact side bearings to help minimize undesirable truck action. Such devices may be included in some cases if actual service testing should indicate their need. Regarding elliptic springs, I agree with Mr. Barrows' comment that they may be used to break up vertical synchronism or resonance in the load-carrying coils, but would like to mention that such applications generally require supplemental means to control lateral and out-of-square forces.

ROBERT B. COTTRELL.[3]

[1] Vice-President, The Symington-Gould Corporation, Rochester, N. Y. Mem. A.S.M.E.

[2] "Developments in the Freight-Car Truck," by R. B. Cottrell, MECHANICAL ENGINEERING, vol. 67, 1945, pp. 517–519.

[3] Chief Mechanical Engineer, American Steel Foundries, Chicago, Ill. Mem. A.S.M.E.

Diesel-Engine Bearings

COMMENT BY JOHN P. MEGROOT[4]

It may be of interest for readers to know what Rudolph Diesel himself thought at the time of the Power Conference in Berlin on the matter of bearing troubles which is the subject of the present paper.[5]

At that conference, which was held in 1909, the writer had the privilege of congratulating him on the big step he had made in the field of power generation. Waving his hand in deprecation, he said that his work amounted to nothing as yet, and stated further, "There is trouble ahead."

I asked, "What trouble do you see, Doctor?"

He replied, "Well, in the first place we do not know a great deal about the phenomena of combustion yet. In the second we will have bearing troubles and we will probably have to do a great deal of research work in that direction in order to eliminate all of the difficulties."

He said, "There is a great possibility that our pressures will puncture the oil film and in that case we will have to look for another lubricant. Most likely if we look through a microscope what we think is a perfectly straight line will be something like a wavy line. We take two of these perfect surfaces, as we think of them, and put them over each other, and if there is nothing in between that keeps them rolling then we naturally must get wear. Therefore, it is very urgent that under the enormously high pressures," and he predicted that we might expect exceedingly higher pressures, "when the maximum pressure occurs, it is merely a question of our

[4] Engineer-Consultant, Cleveland, Ohio.

[5] "Diesel-Engine Bearings—Discussion of Failures and Progressive Inspection Methods," by L. M. Tichvinsky, MECHANICAL ENGINEERING, vol. 67, 1945, pp. 297–308.

lubrication having a film thickness great enough that it exceeds the thickness of the slight deviations in the surface."

In conclusion, can the author supply information on the subject of silicon lubrication?

COMMENT BY MILTON C. SHAW[6]

Is bearing erosion experienced in regions other than the location of the oil hole in the Diesel, and if so, what is the explanation for this condition of erosion and how does it differ from the erosion that is mentioned in connection with the reversal of flow near the oil hole?

COMMENT BY JOHN K. ANTHONY[7]

There has been a lot of discussion on the subject of heat generated when supercharging Diesel engines. We have found, in a number of cases where various types of lead-base babbitts are bonded to bronze-backed materials, that although the bond is very good in the as-cast condition, after prolonged heating at normal operating temperatures for a bearing, say, 300–325 F for 30 or 40 hr, the bond is materially weakened. Has the author experienced this phenomenon in his work with lead-base babbitts, particularly with respect to Satco when bonded to a bronze backing?

COMMENT BY PAUL A. BECK[8]

The author's data on the hardness of bearing alloys at various temperatures are given in Fig. 4 of the paper. These data suggest that in the whole range of bearing temperatures Satco is superior to another lead-base alloy which is not further identified in the paper. It is, however, implied that the curve marked "lead base" is representative of the hardness of lead-base bearing alloys in general, other than Satco. The author concludes: "In the group of white bearing metals, comprising Satco, tin-base and lead-base babbitts, Satco possesses the highest physical properties at elevated temperatures."

This statement is certainly incorrect. The lead-base babbitt used for comparison is obviously not one of the newer arsenical-lead babbitts; it may be A.S.T.M. No. 7 (S.A.E. No. 14) or a similar alloy. It is known that the arsenical lead-base babbitts have superior high-temperature hardness as compared with the conventional lead babbitts. As a result, the babbitt used to compare Satco with the other lead-base alloys is not at all representative of the lead babbitts currently used.

The second and main reason why the author's hardness data are misleading as presented is that they are obviously based on tests with material not exposed to the test temperatures for any prolonged periods of time. What counts in actual use is the hardness or strength after the bearing alloy has been exposed to the running temperatures for some time, which may be quite different from the hardness measured immediately after the bearing alloy reaches temperature. Fig. 1 of this comment gives the Brinell hardness number (100 kg, 10-mm ball, 30 sec) at 300 F of Satco and of an arsenical lead babbitt (A.S.T.M. No. 14) after various periods of exposure to the testing temperature. It is seen that Satco loses its superiority in 12 hr and that its hardness drops considerably below that of the arsenical lead babbitt if the exposure is prolonged to several days. This is undoubtedly due to the fact that Satco owes its hardness to aging due to the precipitation of an intermetallic compound, and that overaging takes place readily at 300 F.

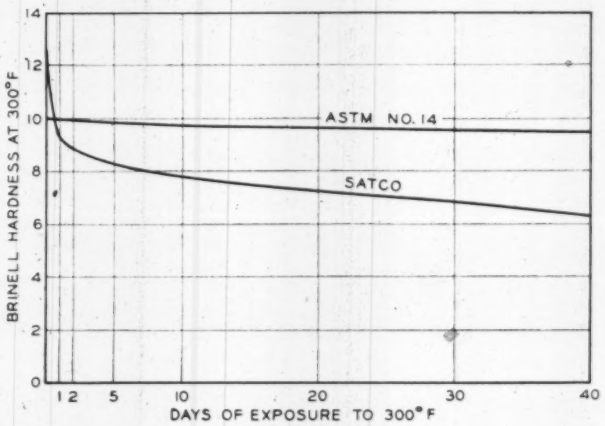


FIG. 1

AUTHOR'S CLOSURE

Mr. Megroot's question with respect to silicon lubrication is a very interesting one. Silicon lubrication falls in the group of the so-called synthetic lubricants. Such lubricants have been studied and developed during the war under strict secrecy because basic elements for their manufacture are available in the former axis countries. One of the advantages of the silicon lubricant is its desirable viscosity-temperature relationship which permits their use at comparatively high temperature at continuous rating. Available information indicates that the lubricant has also satisfactory detergency, antioxidation, and pour-point characteristics.

Corrosion or erosion cavitation may occur due to possible cyclic reversal of the oil flow produced by the inertia force of the oil column in the connecting-rod bore. Such type of corrosion is first manifested near the connecting-rod-bearing oil hole where the sudden change in the flow direction may enhance erosion. For this reason the intensity of such erosion will be greater near the oil hole than at other load-carrying bearing areas. This phenomenon is naturally apt to occur in high-speed engines. An analysis of this is completed and is illustrated with an eroded bearing presenting the best answer to Mr. Shaw's question.

Mr. Anthony raises an interesting question. It has been observed on a number of occasions that bronze-backed bearings after prolonged operation at high temperatures may fail because of poor bond. Subsequent analysis revealed porous bronze at failed areas. Such failures were explained as due to the possibility of foreign material and gases being trapped in the porous region, all of which weakened the bond.

Localized porous areas were characteristic of sand-cast bronzes. The present technique of centrifugally cast bronze shells produces dense and homogeneous structure precludings localized porosity.

Mr. Beck's discussion with the graph, Fig. 1, was first seen by the author on the galley proof. Clarification of certain statements made as well as rectification for possible erroneous interpretation of Mr. Beck's data are necessary.

The author presented a description of hardness of bearing materials on sixteen lines of the paper accompanied by the chemical analysis of several heavy-duty bearing materials, Table 1, and by hard-

[6] National Advisory Committee for Aeronautics, Cleveland Air Port, Cleveland, Ohio.

[7] Metallurgical Department, The Cleveland Graphite Bronze Company, Cleveland, Ohio.

[8] Head of Metallurgical Laboratory, The Cleveland Graphite Bronze Company, Cleveland, Ohio.

ness-temperature relationship of these materials on a graph, Fig. 4. For convenience most of this description and both the table and the graph are presented on the upper part of the same page.

Mr. Beck probably overlooked the table of chemical data of the tested bearing materials since arsenical lead babbitt was intentionally omitted on account of very large discrepancies of its reported hardness data at elevated temperatures. Thus, the hardness of the alloy "Palid" (6.0 per cent As; 8.0 per cent Sb, and 86.0 per cent Pb) is 6.5 Brinell at 300 F[9]). The hardness of another arsenical lead alloy (0.75–1.25 per cent As; 14.0–16.0 per cent Sb; 0.75–1.25 per cent Sn; 0.4–0.6 per cent Cu, and balance Pb) was reported to be 6.4 Brinell at 300 F.[10]). The Federated arsenical babbitt "S" (1.0 per cent As; 15.0 per cent Sb; 1.0 per cent Sn, 0.5 per cent Cu, and remainder Pb) has the following hardness data at 302 F.: 7.4 Brinell after $1\frac{1}{2}$ days at 302 F., 7.0 Brinell after 7 days at 302 F, and 6.4 Brinell after 46 days at 302 F.[11]). Mr. Beck's hardness value of the arsenical lead babbitt is the highest of all and is equal to 10 Brinell at 300 F, Fig. 1.

It is regretted that the presentation of Mr. Beck's data on the graph, Fig. 1, is not supplemented with chemical data. Obviously one can readily observe that an alkali-hardened lead with 1.0 per cent Sn and an alkali-hardened lead with, say, 4.0 per cent Sn will yield quite different hardness data. Were this graph demonstrated during the meeting, it is certain that followed discussion would require alterations which would change a sales-promotion-type curve into a technical one which then would be of value to designers.

L. M. TICHVINSKY.[12]

[9] "Bearing Metals From the Point of View of Strategic Materials," by H. W. Gillett, H. W. Russell, and R. W. Dayton, *Metals and Alloys*, September, October, November, and December, 1940, p. 636.

[10] Bearing Metals Data, Federal-Mogul Corporation, p. 122.

[11] Federated Babbitts "G" and "S." Booklet by the Federated Metals Division of the American Smelting and Refining Company.

[12] American Bearing Corporation, St. Louis, Mo. Mem. A.S.M.E.

Feedwater Treatment for Locomotives

COMMENT BY ROBERT ADAMS CARR[13]

The author has given a concise outline[14] of the very important savings in boiler repairs and increased locomotive availability accomplished by the New York Central System through its comprehensive program of complete water treatment. He has modestly glossed over the tremendous amount of hard work that is involved in bringing to the fullest success a project of this kind. It involves not only the mechanical department but also the operating department, the engineering department, and the stores department with all of their various subdivisions down to the personnel who keep the water-treating plants charged with chemicals, carry out the boiler blowdown schedules both on the locomotives and at the terminals, and wash boilers at prescribed intervals.

That these diversified divisions of the railroad organization, many of them far removed from the specialized field of the boilermaker, have come generally to appreciate the very definite value of systematically carried out water treatment, is a tribute not only to the soundness with which the chemists and engineers laid out their original project but very much a tribute to the intelligence and unceasing diligence of the water-treatment supervisors responsible for the field control. This pertains to every railroad where complete water treatment is being carried out in accordance with present-day standards.

The term complete water treatment, as it is used today, covers internally reacting, prepared boiler-water chemicals automatically applied at the water station by mechanical means, or manually applied directly to the locomotive tender, as well as the externally reacting water softeners of the lime-and-soda, zeolite, or ion-exchange type. The ultimate aim, as the author mentioned, is to produce a satisfactory boiler water. Practical experience has defined a satisfactory boiler water as one having a zero hardness with a proper ratio of alkalinity to total dissolved solids in a predetermined economical range, and a correct causticity balance in relation to both alkalinity and total dissolved solids. Simple field tests readily determine these factors.

Partial treatment, by any method, has been proved uneconomical, as the author points out, when the relatively small increase in chemical cost, to achieve complete treatment, is balanced against the definitely improved boiler cleanliness and the greater freedom from foaming. Practical experience has proved that a fully treated boiler water actually carries better and is easier to control by chemical antifoams or by systematic blowdown than a partially treated water.

In recent years, it has become rather general practice to add an organic or a prepared organic-inorganic finishing treatment to externally treated water to overcome foaming, intercrystalline cracking, corrosion, and silica scale. These chemical costs, added to the overhead on the investment in external softening facilities, and the generally increased operating attention required, place the modern, automatic, mechanical wayside feeder using a liquid mixture of soda ash and prepared supplementary chemicals in a very favorable position as to over-all cost of treatment. Unless clarification is required because of excessive pollution or mud, waters of 30 grains total hardness and over are being successfully handled by internal treatment.

On one section of the New York Central System, where all of the water is internally treated by liquid feeders using soda ash in combination with prepared supplementary chemicals shipped in powdered form, waters of from 7 to 30 grains total hardness are being treated with no noticeable difference in their performance in the locomotive boilers. Boilers are washed at 30-day intervals, and shoppings for boiler repairs have been extended from between 45,000 and 60,000 miles to between 300,000 and 500,000 thousand miles.

Wayside feeders, pumping a liquid treatment prepared at the treating plant by dissolving soda ash with other specified chemicals in a calibrated mixing vat, are preferred over by-pass feeders using solid forms of prepared treatment, because of the greater reliability of the liquid feeder in maintaining set chemical dosages and their greatly reduced chemical cost.

The author describes how the water-treatment program on the New York Central grew from its inception in 1924, until, within the last 7 years, all of the ramifications of the New York Central System operate under the benefit of some type of water treatment. An interesting aspect of this development has been that as the worst waters have been improved by treatment, the next best waters have become relatively the worst until now the New England waters, which originally in their raw state were considered the standard of comparison for the rest of the system, are now receiving automatic wayside treatment to bring them up to

[13] President, Dearborn Chemical Company, Chicago, Ill.

[14] "Feedwater Treatment for Locomotive Use—Some Practical Aspects," by T. W. Hislop, MECHANICAL ENGINEERING, vol. 67, 1945, pp. 515–516.

par as established by the other treated districts.

It is significant that, under a properly controlled water-treatment program, the washing and repairing of the steam locomotive boiler is no longer the limiting factor in locomotive availability, and the modern, reliable, readily maintained, steam motive-power unit is making some remarkable records.

COMMENT BY J. R. JACKSON[15]

In commenting on this paper, the writer will restate some points made in discussing a paper[16] presented by R. C. Bardwell before the Railway Fuel and Traveling Engineers' Association at its 1941 annual meeting:

The accomplishment of the water engineers toward the betterment and economy of steam-locomotive transportation are accepted facts, and it is not my desire or purpose to detract in any degree from the splendid work they have done. I would like, however, to point out what, in my experience and judgment, still constitutes a fertile field for improvement through the treatment of boiler waters from the standpoint of foam control to provide "solid water" to a degree where on-line foaming will be reduced to a point where it is no longer an operating factor. Mr. Bardwell mentioned proper blowdowns as one of the biggest steps in the improvement of locomotive-boiler conditions and fuel economy. There is no question as to the betterment in boiler conditioning brought about through blowdowns at terminals and on-line; there is question as to the fuel economy where, by reason of the quality of the natural waters available for locomotive use, the blowdown required to keep boiler-water concentrations within the foaming range amounts to from 15 to 25 per cent of the total water supplied as is the case with some waters we have to contend with in our territory. The practice is economically justified only because the water engineers have not developed a treatment for available waters to reduce foaming and excessive on-line blowing of boilers. Perhaps that is not practicable; it has been accomplished on an experimental basis on our railroad. The solution of this problem is a challenge to the water engineers of the country.

The writer is glad to say that, since the foregoing remarks were made 3 years ago, a subcommittee of the A.R.E.A. water committee has carried out studies which have contributed to a better knowledge of foam phenomena and control, and that there has been considerable activity in this direction by other investigators.

On the Missouri Pacific Lines, we have been quite active during the past 5 years in an endeavor to solve the foaming problem through supplementary antifoam treatments and have made a decided improvement in this direction over the castor-oil-base materials formerly available and generally used by railroads west of the Mississippi River for a period of many years prior to this war. At this time, we cannot say that the new commercially available antifoam compounds are either equally effective with all combinations of water encountered on our system or that control of their application is a simple or foolproof matter. We have, however, carried out some large-scale experiments which indicate that it should be possible eventually to control foaming in steam locomotive boilers through supplementary antifoam treatment. The writer can quite definitely state that extensive use of an antifoam powder materially contributes to the excellent record in handling the unprecedentedly heavy business, on the railroad system with which he has been connected, during the past 7 years.

The key to the problem is the successful handling of the dissolved and suspended matter in the highly concentrated waters remaining in the boiler after the evaporation of the chemically treated water now generally supplied for steam locomotive boilers.

The writer has great faith that through co-operative research, the railroad water-treating engineers and technical organizations of the supply industry will eventually provide a practicable solution to the remaining water problems. We have come a long way in water treatment during the past 40 years but the job is not completed, and we may reasonably expect continued progress during the years ahead.

BY V. E. MCCOY[17]

This paper clearly establishes the practical value of a comprehensive system of water treatment to steam-locomotive operation. We, who are engaged in this work, take great pride in the results that are being reported.

At a meeting in Chicago in November, 1942, a number of prominent railroad executives spoke on locomotive utilization, and the following statements are typical of what they had to say about water treatment:

"Improved water treatment has done more to promote intensive utilization of power than any one thing."

"This alone (reduction of flue failures by water treatment) has been one of the greatest factors in permitting increased locomotive availability."

These testimonials for water treatment mean but one thing. Through this one agency alone the railroads are able to increase greatly the number of hours of work that can be obtained from each locomotive every month.

This point is best illustrated by the fact that the railroads are handling the greatest traffic load in history with some 20,000 fewer locomotives than in the last war. This is a reduction of nearly one third in the actual number of units. The war effort would have been greatly handicapped if it had been found necessary to build even 10,000 new locomotives, probably costing around $1,500,000,000, before we could have handled the war traffic.

Obviously, a number of factors contribute to this remarkable performance. The existing inventory of locomotives averages somewhat larger in horsepower; they have many modern devices which improve efficiency and performance; and terminal facilities have been improved to expedite handling.

However, the heart of the locomotive is still the same basic boiler that has been used for over 50 years, and the performance of the entire unit depends entirely upon its functioning properly. This paper points out that water treatment has greatly reduced boiler maintenance on the New York Central System, and similar results are being obtained on other railroads.

When the locomotive machinery requires repairs, it is usually only necessary to apply new parts from stock which are readily interchangeable and, for the most part, this requires only a few hours to accomplish. But, if the boiler requires repairs, these have to be tailor-made and fitted on the boiler itself, and it is a matter of tying up the entire locomotive until this work is completed. In side-sheet renewal, this may take a matter of weeks rather than hours.

Water treatment has largely eliminated the requirement for intermediate boiler repairs between shoppings, and, in the words of the Master Boiler Makers' Association in 1941:

". . . . . one of the biggest changes that has occurred in locomotive practice, and the one which has been brought

[15] Engineer of Tests, Missouri Pacific Lines, St. Louis, Mo. Mem. A.S.M.E.

[16] "Fuel Economy From the Viewpoint of the Water Engineer," by R. C. Bardwell, Proceedings, Railway Fuel and Traveling Engineers' Association, 1941.

[17] Chief Engineer, National Aluminate Corporation, Chicago, Ill. Mem. A.S.M.E.

about solely due to the water treatment program, has been the shopping of locomotives on the basis of required repairs to machinery as compared to the previous practice when boiler conditions governed the time at which it was necessary to put the locomotives in the back shop for repairs."

This same report gives detailed information on the reduction in boiler work due to water treatment that is truly remarkable; to anyone wanting details, reference should be made to that report.

The paper under discussion points out that co-operation between various departments is of paramount importance if best results are to be obtained. We heartily endorse this statement. Co-operation must be continuously maintained between the mechanical, operating, engineering, and purchases and stores departments. The impurities in locomotive water supplies are ever present in the raw water. Failure to apply corrective chemical treatment and neglect to care properly for and operate both the treating plants and the locomotive boilers will inevitably result in loss to the railroad.

The New York Central System has eliminated one source of human failure in providing automatic blowdown means for its boilers. While blowdown is distinct from water treatment, failure to provide proper blowdown can largely nullify any water-treatment program. Proper handling of the blowdown of locomotive boilers on the road will eliminate sludge and dissolved solids. If these are allowed to accumulate in the boiler, serious failures may result from mud burns, or bad delays due to foaming may occur.

Where manual blowdown is relied upon, continuous close supervision must be provided to insure compliance with instructions. Co-operation by the enginemen and operating officials in this respect are of the utmost importance. This one element deserves and actually requires the closest attention. Its importance cannot be overemphasized.

Through the years in which the railroads have installed the water-treatment program, the direct supervision and development of this work has been largely entrusted to a group of men in the American Railway Engineering Association, known as the Water Service Committee. These men, working co-operatively with other departments of the railroads, with equipment companies, and with chemical companies, have contributed in a large degree to the accomplishment of railroad management which now makes two locomotives do work formerly requiring three or more. Everyone must agree that this is an outstanding achievement.

COMMENT BY W. A. POWNALL[18]

Until comparatively recently, railroads have been lamentably slow in developing water treatment, but during the last few years there has been a decided improvement, and most roads now use some form of water treatment to reduce or prevent scale formation in locomotive boilers. They have competent water engineers for supervising the treatment, and manufacturers of boiler compounds have well-organized forces of traveling representatives who understand the principles of water treatment, and who instruct and supervise the carrying out of treatment on roads where they are concerned.

The decrease in locomotive failures resulting from leaking flues, brought about by the electric-welding of flues to the back flue sheet, has undoubtedly largely contributed to delaying action on water treatment. Years ago roads operating under hard-water conditions had an enormous number of road delays caused by leaking flues, and they were forced to adopt some form of water treatment to reduce scale formation, and thus decrease the "giving up" of trains due to flues leaking on the locomotive. On the Wabash in the pretreatment days there were nearly 1000 locomotive leaking-flue failures in a year. Now with treated water, we may have a single leaking failure a year; and this elimination was not accomplished by welding, for we do not weld the small flues to the flue sheet. Our treatment was started in 1912. Waters were of all the qualities found between Buffalo and Omaha, and Kansas City, and Chicago and St. Louis. However, with one exception, where high hardness and high iron content justified a lime-soda plant, the use of soda ash alone produced the desired result. The following specific improvements confirm those of the author:

Practical elimination of locomotive failures caused by leaking flues, stay bolts, or fireboxes.

Increase in time between flue resetting from 6 to 12 months, to 4 to 5 years.

Reduction of 95 per cent in broken stay bolts.

Firebox renewals reduced from 12 per 100 engines per year, to 0.4 per 100 engines per year.

Firebox sheets or part-sheet replacement reduced 90 per cent.

Period between boiler washouts increased from 10 days to 30 days.

Fuel consumption reduced 10 to 20 per cent.

Greater emphasis should be placed on the matter of better water supply. Any plan of water treatment should include a careful survey of existing supplies, and with a view of replacing bad water with waters of better quality, providing the expense of the change is not prohibitive. "Mother Nature" is an excellent and reliable supervisor, and it is very desirable if she can provide well waters that carry a moderate amount of sodium carbonate. These waters are already treated and need no control. One instance may be cited where we used a well water high in sulphate hardness that required many tons of soda ash annually to render it nonscaling. Then after careful survey another stratum was located within a mile of the old location, the new water having about $^1/_3$ the total hardness and containing 2 grains of sodium carbonate per gal. No treatment whatever was required with the new supply.

The blowing down of locomotive boilers is of special importance. Any form of treatment that reduces sulphate scale increases the alkali content of the water in the boiler, and this in time produces a foaming condition, unless relieved by replacing in part the concentrated water in the boiler. The author covers this well in his paragraphs on "Locomotive Blowdown Facilities."

One point that the writer would like to mention is the location of the main blowoff cock. Assuming full treatment of all waters, there should be no scale in the boiler, but there will be a certain amount of precipitated lime salts and other suspended matter. The natural circulation in the boiler carries this matter toward the rear, part deposits on the side mud ring near the back, the most of it is deposited at the point of lowest circulation which is under the door on the back mud ring. The most favorable blowoff cock location is then in the back corner, with a perforated pipe connected to it and lying on the back mud ring. The use of this back water-leg blowoff cock at terminals, and the occasional use on the road, supplementing the continuous blowdown, will keep the boiler practically clean of suspended matter. Incidentally, the writer cannot quite agree with the statement that less blowdown is required where the complete softener is used. This of course seems reasonable, but he has not yet seen any proof that a boiler can be operated at a higher dissolved-solids content in the

[18] Assistant to Superintendent of Motive Power, Wabash Railroad Company, Decatur, Ill.

water before foaming occurs with a softener-treated water, as compared with partial-treatment methods.

AUTHOR'S CLOSURE

The constructive nature of the discussions by Messrs. Carr, Jackson, McCoy, and Pownall is much appreciated.

With respect to prevention of foaming in addition to on-the-road use of the continuous and manual blowdowns as outlined in my thesis, determination of the dissolved-solids content of each boiler water is performed on the locomotive's arrival at terminals to ascertain if proper blowdown had been performed or if additional terminal blowdown is necessary before dispatchment.

Actual measurements of amount of water discharged by the continuous blowdown have shown that, on an average run from Harmon, N. Y., to Chicago, the water thus lost is less than 12 per cent of the total water supplied to the boiler. Furthermore, the average temperature of the water blown out of a 225-lb-pressure boiler en route, was found to be only 310 F and therefore the fuel loss is smaller than might be supposed.

The use of antifoam compounds under existing operating conditions has been found to be unwarranted on the New York Central except on one short division.

T. W. HISLOP.[19]

[19] Water Service Engineer, New York Central System, New York, N. Y.

A.S.M.E. BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code may communicate with the Committee Secretary, 29 West 39th St., New York 18, N. Y.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are then sent by the Secretary of the Committee to all members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and is passed upon at a regular meeting.

This interpretation is later submitted to the Council of The American Society of Mechanical Engineers for approval after which it is issued to the inquirer and published in MECHANICAL ENGINEERING.

Following is a record of the interpretations of this Committee formulated at the meeting of Oct. 26, 1945, and approved by the Council on Dec. 7, 1945.

ANNULLED CASES

Case Nos.

929—Upon recommendation of inquirer
944—Revision of Par. P-332
1008—Revision of Par. P-20
1009—Revision of Pars. P-108 (*b*), P-268 (*p*), U-59 (*p*)
1012—Revision of Par. P-7 and Table P-9
1013—Revision of Par. P-186 (*c*)
1016—Revision of Pars. U-41 (*b*)(6) and (*c*)
1020—Revision of Par. U-208 (*c*)

CASE NO. 1022

(Interpretation of Par. Q-205)

Inquiry: Par. Q-205 of the Code requires welding-operator tests for groove welds to be made in materials $^3/_8$ in. thick and that when using pipe or tubing, the nominal diameter shall be not less than 6 in. Is it mandatory that these values be adhered to in all cases?

Reply: The tests described in Part II of the Welding Qualifications Section of the Code are intended for universal qualification of a welding operator and the thicknesses designated were chosen for that purpose. Material having a thickness less than $^3/_8$ in. may be used but in that case the operator shall not be considered qualified for a thickness greater than twice that used in the tests.

If the thickness of the test specimen is other than $^3/_8$ in., the testing shall be done in a guided-bend test jig with the plunger and die member proportioned as follows:

Thickness of plunger member = 4 × thickness of test specimen
Radius of plunger member = 2 × thickness of tests specimen
Width of opening, die member = 6 × thickness of test specimen plus $^1/_8$ in.
Radius of die member = 3 + thickness of test specimens plus $^1/_{16}$ in.

In the case of pipe or tubing having dimensions such that testing in a guided bend test gig cannot be done satisfactorily, the specimen shall be prepared by simulating the full procedure proposed for the actual work to be done. This specimen shall be of the dimensions and tested as shown in Fig. 43. When so tested, the specimen shall develop the full specified minimum tensile strength of the annealed base material (minimum of the range), when tensile strength is covered in the material specification involved.

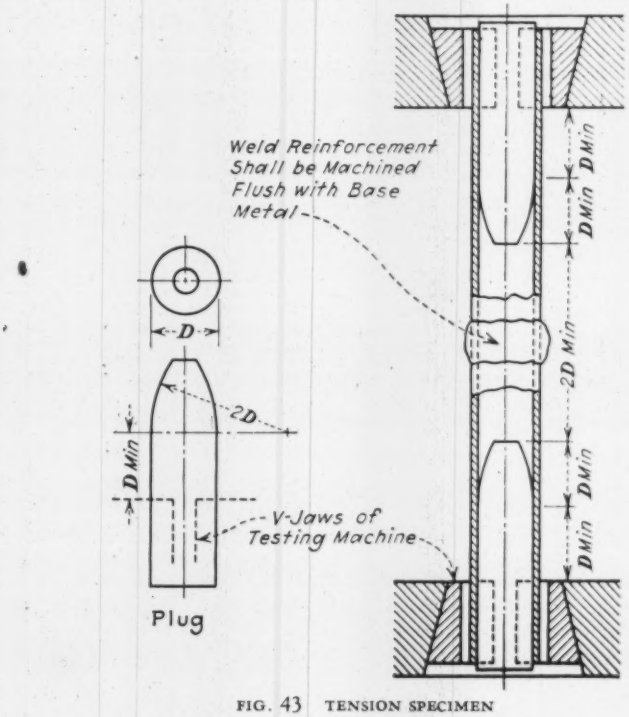


FIG. 43 TENSION SPECIMEN

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

The Pursuit of Happiness

REHABILITATION: THE MAN AND THE JOB. Report of the Subcommittee on Rehabilitation of the Committee on Work in Industry, National Research Committee, Washington, D. C. Reprint and Circular Series, No. 121, March, 1945. Paper, 6¾ × 9¾ in., 73 pp., 14 figs., $0.25.

REVIEWED BY ALLAN R. CULLIMORE[1]

REHABILITATION: The Man and the Job, the report of the Subcommittee on Rehabilitation of the Committee on Work in Industry of the National Research Council, deserves the *careful* perusal of all those who are interested in rehabilitation, particularly in its broader phases and in its philosophy. The report of the committee is condensed and will require careful reading, but those who have had a considerable experience with vocational counseling in the field of the veteran will recognize in it an extremely valuable document. Space limits a detailed discussion, but one or two matters might well be pointed out which are so important as to warrant the widest distribution and consideration at the hands of those interested in rehabilitation.

Of primary significance, perhaps, in the whole report is the assumption that in the main two types of guidance are available, external and internal. The fact is stressed that the problem of guidance is essentially that of the individual adjusting himself to the environment, not primarily that of the environment adjusting itself to the individual. The point is extremely well taken and, it seems to the reviewer, the most vital one in the whole picture of rehabilitation. The distinction between these types of interview, "counselor-centered" and "client-centered," should be basic in the thinking of all of us.

"Put in broader terms, the individual has a tremendous drive toward growth and maturity and positive health. The war has shown with striking clarity the capacities for adaptation and for growth which exist within each individual. The primary aim of client-centered counseling is to release these forces, to free the individual to go on growing, when conflict, or circumstance, or doubt has halted him. It is this strength within the individual, not the strength within the counselor, upon which we must rely."

The thing which we must do is to make it clear and possible, if not easy, for the man to pursue his own happiness, and that will to work and will to pursue is a thing which the man must furnish himself. The distinction drawn between the two types of counseling is clear, straight, and effective reasoning, and the insistence that the "client-centered" type of counseling is a sound type is inescapable.

Two other specific things in the report would seem to warrant mention and may give some idea of the soundness and the value of the publication. One has to do with the basic fact that a man is placed in a job or a position on the basis of what he can do in that particular area on the basis of the positive things, not on the basis of the negative things. The disability is specific and people are hampered by their disability only with respect to specific areas. Out of this grows the thought that veterans' problems are not so different from the problems of peacetime civil life, in that most of us are hindered or disabled with respect to work in certain areas.

One other thing probably warrants passing mention, and that is the question of irritability. The report is singularly free from medical terms involving mental and emotional considerations which are not understandable to the average layman, but it does mention the question of irritability. The fact that it is something which is well within the experience of most of us is important, particularly at first in dealing with some of our returned servicemen. These fellows are just naturally sore—or perhaps in a formal review of this kind it is best to refer to them as irritable—but irritability is an entirely temporary condition, one that all of us share with the returned servicemen. Even within the experience of the interviewer it extends to criticism of certain governmental functions, and even in this extreme form it indicates nothing of mental or emotional instability. Let us strain a little to apply the word "normal" to these men rather than "abnormal."

The reviewer might go on at considerable length and give some other ideas from a very suggestive and provocative report, but perhaps it is enough to say that it puts forward in a minimum of space certainly the most basic factors with which the interviewer and counselor has to deal in handling the returned veteran.

[1] President, Newark College of Engineering, Newark, N. J. Mem. A.S.M.E.

Rolling Bearings

ROLLING BEARINGS. By R. K. Allan. Sir Isaac Pitman & Sons, Ltd., London, Eng.; Pitman Publishing Corporation, New York, N. Y., 1945. Cloth, 5½ × 8⅜ in., 401 pp., illus., 30s.

REVIEWED BY L. C. FISK[2]

"ROLLING BEARINGS," by R. K. Allan, is an outstanding work. It is a text book on the subject of ball and roller bearings, which fills a long-felt need.

Beginning with the early historical background the author proceeds under sections entitled Fundamental and Elemental to acquaint his reader with basic facts which begin to remove some of the mysteries not touched upon in most manufacturers' catalogs. These two sections are replete with diagrams, and the mathematical analyses are clearly set forth in the simple terms of algebra and the functions of angles.

In discussing materials and manufacture the author appears to evidence a preference for the use of high-carbon alloy steel vs. low-carbon carburizing steels and he describes the carburizing process as applied to straight carbon steels. The reader can but assume, therefore, that the author has not had the opportunity to become as familiar with the very successful carburizing practice developed in this country by two of the largest manufacturers of roller bearings, who use quality low-carbon alloy

[2] Eastern Sales, Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

steels which have been evolved through years of research and experience.

The text on manufacturing process is of distinct value to anyone concerned with bearing specifications and application because it so clearly defines what constitutes reasonable accuracy and quality and what is involved when one insists upon exceptions to accepted standards.

Sections 5 and 6, entitled Theoretical and Empirical, make a forthright presentation of the basic theory developed by Hertz and amplified by Striebeck and Goodman, who are the earliest authorities. The practical formulas given in these chapters are for the most part developed in a step-by-step manner so that even though the reader is asked to take certain expressions on faith, they become understandable because all the separate terms used are clearly defined and developed. The author goes still further in making sure that his reader will be able to make correct use of these formulas by including in the text many typical problem solutions in which he makes application of these formulas. Care has been taken in arrangement of these problems to proceed from the simple to the more complex. It is in these two sections that the reader will most appreciate the author's unique numbering of figures and formulas which facilitates the "ready reference" necessary to understanding the immediate subject matter, and he will find particularly helpful the complete table on notation under section 15 in the back of the book.

Section 7 treats the subject of endurance in much the same manner and presents much factual data in the form of curves and charts.

In succeeding sections the author rounds out the text most thoroughly with discussions on bearing selection application, lubrication, etc.

We have, therefore, a text on ball and roller bearings which every engineer and engineering student may not well overlook as a part of his library of knowledge and reference.

Airframe Materials

REVIEWED BY WILLIAM SCHROEDER[3]

AIRFRAME MATERIALS. By F. S. Stewart. McGraw-Hill Book Co., New York, N. Y., 1945. Cloth, $5^1/_4 \times 8^1/_4$ in., 237 pp., illus., $2.50.

AIRFRAME materials may rightly be considered as a special branch of structural materials. In most airframe materials strength and weight are the paramount considerations. Other properties are generally of secondary importance. Corrosion is usually a problem in that it affects the strength of the material. The processing of the material is in general directed toward obtaining the most favorable ratio of strength to weight possible.

The author discusses many subjects, some of them rather lightly, related to airframe materials such as alloy constitution, heat-treatment, physical properties, corrosion properties, methods of joining, methods of forming, and other phases of processing and fabricating. Nonmetals as well as metals are discussed. The subject matter is aptly supplemented with illustrations.

The book is probably best suited to the reader with some knowledge of mechanics of materials who wishes to acquire a cursory knowledge of aircraft materials and processing practices.

[3] Roscoe, Calif.

Books Received in Library

CONTROLLERS FOR ELECTRIC MOTORS. By H. D. James and L. E. Markle. McGraw-Hill Book Company, Inc., New York, N. Y., 1945. Cloth, $5^3/_4 \times 9$ in., 324 pp., illus., diagrams, charts, tables, $3.50. The construction, performance, and operation of all types of commercial motor controls in general use are described. Protective devices are explained in detail, and brief instructions for installation and maintenance are included. Special control systems, such as for elevators and steel mills, are not considered. The book is intended for technical students as well as for operating men and application engineers, and the treatment is such that only a limited knowledge of electric motors is required.

EXPERIMENTAL STRESS ANALYSIS, Proceedings of the Society for Experimental Stress Analysis, Vol. 2, No. 2. Addison-Wesley Press, Cambridge, Mass., 1945. Cloth, $8^1/_2 \times 11^1/_4$ in., 166 pp., illus., diagrams, charts, tables, $5. This semiannual publication contains the major portion of the papers delivered at the meetings of the Society. The first eleven papers of the present issue deal with a variety of topics: Fatigue resistance, plastic-flow problems, analogic experimental methods in stress analysis, and residual stresses. The last four papers were contributed to a special symposium on crankshaft stresses.

HOW TO SOLVE IT, a New Aspect of Mathematical Method. By G. Polya. Princeton University Press, Princeton, N. J., 1945. Cloth, $5^1/_4 \times 8$ in., 204 pp., diagrams, tables, $2.50. A simple, logical general method for the solution of problems is presented. The illustrative material is largely mathematical, but the method is applicable in principle to many scientific, engineering, or even social problems.

MANUAL OF INSTRUCTIONS ON PROPER FIRING METHODS in the interest of Fuel Combustion and Conservation, Air Pollution, Smoke Elimination. Smoke Prevention Association of America, Inc., Chicago 2, Ill., 1945. Paper, mimeographed, $8^1/_2 \times 11$ in., 72 pp., illus., diagrams, charts, tables, limited free circulation with $0.25 mailing charge. Ten articles by various authors are contained in this manual. The following topics are dealt with: Fuel conservation; furnace turbulence; fuel oil and its combustion; furnace dimensions for underfeed stokers; domestic heating with coke; hand-firing coke; smoke reduction in industrial boiler firing; interpreting coal analyses; excerpts from S.M.A. technical manual; instructions for burning low volatile coal.

MEANING OF RELATIVITY. By A. Einstein. Princeton University Press, Princeton, N. J., 1945. Cloth, $5^1/_2 \times 8$ in., 135 pp., diagrams, charts, tables, $2. This is a reissue of Mr. Einstein's classic presentation of his theory of relativity. It is intended for the general reader who has some understanding of modern physics and advanced mathematics. The subject of space and time in prerelativity physics is discussed as well as the special and general relativity theories. An appendix, covering significant advances in this field since 1921, has been included in this new edition.

PLASTICS IN PRACTICE, a Handbook of Product Applications. By J. Sasso and M. A. Brown, Jr. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1945. Cloth, $7^1/_2 \times 11$ in., 185 pp., illus., diagrams, charts, tables, $4. This book brings within one cover a practical review of plastics in all their successful commercial applications, providing a handy key to the essential facts on how and why plastics are used. The treatment is organized around 103 actual uses of plastics, reviewing the problems encountered in developing them and outlining the reasons for the solutions adopted. Much valuable information is given on plastics materials, properties, methods of fabricating, design, and cost factors.

POWER SYSTEM STABILITY, Vol. 1, Steady State Stability. By S. B. Crary. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London, England, 1945. Cloth, $5^1/_4 \times 8^3/_4$ in., 291 pp., illus., diagrams, charts, tables, $4. The fundamental theory underlying maintenance of continuous electric power under normal and abnormal operating conditions is to be provided by a two-volume set of which this is the first. The present volume devotes the first five chapters to the theory required for a study of the steady-state stability characteristics of a system; the last seven chapters discuss the applications of the theory to system design.

SAMPLING STATISTICS AND APPLICATIONS. (Fundamentals of the Theory of Statistics.) By J. G. Smith and A. J. Duncan. McGraw, Hill Book Company, Inc., New York, N. Y., and London, England, 1945. Cloth, $5^1/_4 \times 8^1/_2$ in., 498 pp., diagrams, charts, tables $4. After reviewing basic concepts and definitions, the authors discuss the general theory of frequency curves and the theory of random sampling. Important sampling distributions are derived, and their applications to a variety of problems are illustrated. Both exact and approximate sampling methods are considered with their proper fields of use. The character of assumptions involved in theory is explicitly treated, and the problems that such assumptions present in practical applications are illustrated.

A.S.M.E. NEWS

And Notes on Other Engineering Societies

Council of A.S.M.E. Meets on November 25 and 26

Newly Elected Members Assume Posts at Monday Night Dinner

TRADITIONAL procedure of the Council of The American Society of Mechanical Engineers was modified at the 1945 Annual Meeting of the Society in order to conserve the time and effort of Council members and to permit the organization of the Council for 1946 to be effected as expeditiously as possible. In recent years the Council has met in the early part of Annual Meeting week, following the final session of its Executive Committee. It was then customary to adjourn the meeting until Friday of the same week, when the "old" Council would wind up its affairs, and the "new" Council would immediately convene under the leadership of the newly elected president.

The interval between Monday and Friday under the former procedure necessitated attendance of Council members throughout the entire week or their return on Friday, if business called them away during this interval. This delay was eliminated in 1945 by convening the 1946 Council on Monday evening following a dinner session conducted at the Hotel Pennsylvania. On this occasion the newly elected officers were inducted and the members-elect of the Council took the places of those of the 1945 Council whose terms had expired.

Actions taken at meetings of the Executive Committee and the Council are noted in what follows.

Actions of A.S.M.E. Executive Committee

A meeting of the Executive Committee of the Council of The American Society of Mechanical Engineers was held at the Hotel Pennsylvania on November 25. There were present: Alex D. Bailey, chairman; R. F. Gagg, vice-chairman; Alton C. Chick, D. W. R. Morgan, and A. R. Stevenson, Jr., of the Committee; G. L. Knight (Finance), A. R. Mumford (Sections); D. Robert Yarnall, president-elect; C. E. Davies, secretary; Ernest Hartford, executive assistant secretary; and R. L. Sackett, assistant to the Secretary: Also S. H. Graf, W. A. Hanley, A. J. Kerr, W. H. McBryde, T. S. McEwan, Roscoe W. Norton, J. A. Noyes, J. M. Robert, and F. L. Wilkinson, Jr., members of the Council; S. R. Beitler, J. Calvin Brown, and Linn Helander, Council members-elect; and L. E. Jermy, of the Sections Committee.

The following actions were of general interest.

Personnel Service

It was reported that the Engineering Societies Personnel Service, Inc., had voted to make a reduction of 25 per cent in the fees paid by returning servicemen for securing their first position after return from the Armed Forces.

Power Test Codes

The 1945 edition of the Supplement on Instruments and Apparatus, Part 2, Pressure Measurements, Chapters 2 and 3, was adopted as a standard practice of the Society.

Development Fund

It was reported that contributions to the Development Fund as of Nov. 25, 1945, amounted to $103,154.

Dues of Foreign Members

On recommendation of the Committee on Policy on Dues for Foreign Members a special policy was adopted.

Certificates of Award

Approval was voted of a Certificate of Award for Edgar J. Kates, retiring chairman of the Committee on Publications; for J. N. Landis and L. M. Goldsmith of the Power Division; and for E. D. Haigler and E. S. Lee, of the Industrial Instruments and Regulators Division.

Metals Engineering Handbook

L. K. Sillcox was appointed chairman of the Metals Engineering Handbook Board.

Construction Industry Advisory Council

It was noted that a report had been received of the conference of the Construction Industry Advisory Council, Washington, D. C., Nov. 1, 1945, organized by the U. S. Chamber of Commerce "to help develop construction-industry opinion and to make recommendations for industry and government action in the public interest." M. X. Wilberding was present throughout the Conference and the Secretary was present part of the time. The proceedings are in the files of the Society.

A.S.M.E. Calendar

of Coming Meetings

April 1–3, 1946
A.S.M.E. Spring Meeting
Chattanooga, Tenn.

June 3–6, 1946
A.S.M.E. Aviation
Division Meeting
Los Angeles, Calif.

June 12–15, 1946
A.S.M.E. Oil and Gas Power
Division Meeting
Milwaukee, Wis.

June 17–20, 1946
A.S.M.E. Semi-Annual Meeting
Detroit, Mich.

June 21–22, 1946
A.S.M.E. Applied Mechanics
Division Meeting
Buffalo, N. Y.

September 30–Oct. 2, 1946
A.S.M.E. Fall Meeting
Boston, Mass.

December 2–6, 1946
A.S.M.E. Annual Meeting
New York, N. Y.

American Rocket Society

It was reported that the active membership of the American Rocket Society had approved affiliation with A.S.M.E.

Engineers Joint Council

Approval was voted of a basis for apportioning among the constituent bodies the expenses of the Engineers Joint Council.

Enlargement of the Joint Committee on Economic Status of the Engineer by inviting the National Society of Professional Engineers to become, through representation, a co-operating member of the committee, was approved.

James L. Walsh was appointed a representative of A.S.M.E. on the proposed Joint Committee on National Defense.

Appointments

The following appointments were approved:

Special Research Committee on Theory of Automatic Process Control, Donald P. Campbell, C. O. Fairchild, Herbert Harris, Jr., C. E. Mason, Nicholas Minorsky, George Philbrick, and Albert F. Sperry.

Power Test Codes Committees:

No. 10 on Centrifugal and Turbo-Compressors and Blowers, Austin H. Church, Arthur M. C. Moody.

No. 20 on Speed, Temperature, and Pressure Responsive Governors, H. Steen-Johnson.

Utah State Agricultural College, Inauguration of President, Nov. 16, 1945, W. J. Cope.

State College of Washington, Inauguration of President, Dec. 11, 1945, Karl T. Compton, H. F. Gauss.

Sessions of the Council

Sessions of the 1945 Council of The American Society of Mechanical Engineers were held at the Hotel Pennsylvania on the afternoon of November 25 and the morning and afternoon of November 26.

There were present at the first session: Alex D. Bailey, president; R. M. Gates, W. A. Hanley, W. H. McBryde, and J. W. Parker, past-presidents; R. F. Gagg, David Larkin, J. E. Lovely, T. S. McEwan, D. W. R. Morgan, J. A. Noyes, and F. L. Wilkinson, Jr., vice-presidents; A. C. Chick, S. H. Graf, A. J. Kerr, Roscoe W. Morton, J. M. Robert, A. R. Stevenson, Jr., A. E. White, and E. E. Williams, managers; K. W. Jappe, treasurer; C. E. Davies, secretary; D. Robert Yarnall, president-elect; S. R. Beitler, J. Calvin Brown, and Linn Helander, vice-presidents-elect; E. J. Kates and J. N. Landis, directors-at-large-elect; R. L. Parsell (Constitution and By-Laws), F. G. Switzer (Meetings and Program), W. G. Christy (Registration), A. R. Mumford (Sections), and W. H. Hill (Standardization); A. H. Gottesman and H. I. Kram, junior observers; H. N. Davis, past-president, J. E. Younger (Aviation), guests; C. B. LePage, R. L. Sackett, and George A. Stetson, staff.

With a few exceptions the same persons were present at the session on Monday, with the following additions: H. H. Snelling (Constitution and By-Laws), A. G. Christie (Power Test Codes), J. H. Sengstaken (Professional Divisions), and L. E. Jermy and S. D. Moxley (Sections); R. M. Titus, junior observer; and K. M. Irwin and A. C. Pasini, guests.

The following actions were of general interest:

Annual Reports

Adoption was voted of the annual report of the Council (see pages 44–49 of this issue) and acceptance was voted of the reports of the standing and special committees and of the representatives of the Society on joint activities.

Woman's Auxiliary

Acceptance was voted, with an expression of appreciation of the work being done, of the annual financial report of the Woman's Auxiliary.

Constitution and By-Laws

Numerous amendments to the By-Laws, received for first reading on Dec. 1, 1944, and on June 17–18, 1945, were discussed at length and adopted. These amendments will be published later.

Other amendments to the By-Laws were received for first reading.

Amendments to the Rules were also discussed and adopted. These amendments will be published later.

Research Bills

A. G. Christie, past-president and a member of the panel (See MECHANICAL ENGINEERING, December, 1945, pages 787–788) which discussed legislation for federal aid to science reported to the Council in substance as will be found on page 80 of this issue.

After discussion the Council voted to go on record as opposing the Kilgore bill and favoring the Magnuson bill, the latter as originally presented on July 19, 1945.

25 Years of Service

In conformity with a procedure adopted in 1943 the Secretary presented three members of the staff who have completed 25 years of service, and the Council extended its "sincere appreciation for their fine contributions to the work of the Society." The Secretary, who has also completed 25 years of service, was included in this expression of appreciation.

Atomic Energy

The Council voted to appoint a committee to deal with the engineering applications of atomic power.

Organization Session of the 1946 Council

The concluding session of the 1945 Council and the organization session of the 1946 Council were held at the Hotel Pennsylvania following a dinner for members of the Council and members-elect of the Council. These were present: Alex D. Bailey, president; R. M. Gates, W. A. Hanley, W. H. McBryde, and J. W. Parker, past-presidents; R. F. Gagg, David Larkin, J. E. Lovely, T. S. McEwan, D. W. R. Morgan, J. A. Noyes, and F. L. Wilkinson, Jr., vice-presidents; A. C. Chick, S. H. Graf, A. J. Kerr, Roscoe W. Morton, J. M. Robert, A. R. Stevenson, Jr., A. E. White, and E. E. Williams, managers; D. Robert Yarnall, president-elect; S. R. Beitler, J. Calvin Brown, and Linn Helander, vice-presidents-elect; E. J. Kates and J. N. Landis, directors-at-large-elect; K. W. Jappe, treasurer; and C. E. Davies, secretary.

D. Robert Yarnall Takes Office

Mr. Bailey introduced the Council members-elect and presented Certificates of Award to the following members retiring from the Council: W. H. McBryde, D. W. R. Morgan, J. A. Noyes, F. L. Wilkinson, Jr., Roscoe W. Morton, and A. E. White. He expressed his sincere appreciation of the co-operation he had received from the members of the Council during his administration and stated that it had been a most enjoyable year for him. He then presented the "President's Gavel" to Mr. Yarnall, who called the meeting to order.

Appointments

C. E. Davies was reappointed Secretary; K. W. Jappe, Treasurer; and Joseph L. Kopf assistant treasurer to serve until the end of the 1946 Annual Meeting. Mr. Jappe was also reappointed treasurer of the Development Fund for the same period.

Executive Committee

On nomination of the President, the Executive Committee of the Council was approved as follows: D. Robert Yarnall, chairman, D. S. Ellis, R. F. Gagg, J. N. Landis, and A. R. Stevenson, Jr.

Committees

Appointments and changes in the personnel of Society Standing Committees, as recommended by the Committee on Organization, were approved. [It is customary to issue in February a complete roster of Society Officers and committee personnel for the information and use of members.]

1946 Council

The Council of the Society for 1946 is constituted as follows:

President: D. Robert Yarnall.

Past-Presidents (terms expire at Annual Meeting of year designated): William A. Hanley (1946), James W. Parker (1947), Harold V. Coes (1948), R. M. Gates (1949), and Alex D. Bailey (1950).

Vice-Presidents (terms expire in 1946): Alton C. Chick (I), Rudolph F. Gagg (II), Edward E. Williams (IV), Thomas S. McEwan (VI), and Linn Helander (VIII); (terms expire in 1947): A. R. Stevenson, Jr. (III), Samuel R. Beitler (V), and J. Calvin Brown (VII). Roman numerals in parentheses indicate regions to which the vice-presidents are assigned.

Directors-at-large (terms expire in 1946): Samuel H. Graf, David Larkin, John E. Lovely, and James M. Robert; (terms expire in 1947): Daniel S. Ellis and Arthur J. Kerr; (terms expire in 1949): Edgar J. Kates and J. Noble Landis.

Treasurer: K. W. Jappe.

Secretary: C. E. Davies.

On recommendation of the Committee on Organization it was voted to disband with sincere thanks and appreciation the following special committees of the Council: Development Fund, Kilgore Bill, Manufacturing Engineering, Ordnance Advisory, War Honors, and War Production.

The function of the Special Committee on National Honors was assigned to the Board of Honors and Awards.

The name of the Committee on Registration was changed to Committee on Registration of Engineers.

1946 Annual Meeting

Upon recommendation of the Committees on Meetings and Program and Sections approval was voted of holding the 1946 Annual Meeting of the Society at the Hotel Pennsylvania during the week beginning Dec. 1, 1946.

1945 Annual Business Meeting

The 1945 Annual Business Meeting of The American Society of Mechanical Engineers was called to order by President Alex D. Bailey at the Hotel Pennsylvania on Monday afternoon, Nov. 26, 1945.

C. E. Davies, Secretary of the Society, presented the Annual Report of the Council, which had been preprinted and distributed, and touched on its high lights. The report will be found in this issue, pages 44–49. He then read the Report of the Finance Committee (see pages 49–55 of this issue).

On motion the Report of the Council was approved.

The report of the Tellers of Election for 1946 was then presented by Mr. Davies, and showed the election of the following officers.

Regional vice-presidents to serve two years: A. R. Stevenson, Jr., S. R. Beitler, and J. Calvin Brown.

Regional vice-presidents to serve one year: R. F. Gagg, E. E. Williams, and Linn Helander.

Directors at large: Edgar J. Kates and J. Noble Landis.

President: D. Robert Yarnall.

Announcement was made of an arrangement by which the American Rocket Society had become an affiliate of The American Society of Mechanical Engineers.

Confirmation and approval of the acts of the Council and officers for 1944–1945 was voted.

A motion stating that it was the consensus of the Business Meeting that MECHANICAL ENGINEERING should be printed on paper of better quality as soon as practicable was carried.

Twenty-Second Annual Meeting of Woman's Auxiliary to the A.S.M.E.

Mrs. J. Noble Landis Elected President for 1946

THE Woman's Auxiliary to The American Society of Mechanical Engineers held its 22nd annual meeting Nov. 26–29, 1945, at the Hotel Pennsylvania. Two hundred and forty-one members and guests were welcomed by Mrs. Earle B. Smith, general chairman, and committee chairmen, Mrs. Waldo McKee, Mrs. A. W. Anderson, Mrs. C. P. Bliss, Mrs. A. R. Cullimore, Mrs. H. R. Kessler, Mrs. F. M. Gibson, and Mrs. C. H. Kent. A joint committee consisting of Miss Jo-Anne Wright, Mrs. F. M. Gibson, Jr., and Miss Dorothy Field was in charge of the "AsKme" girls.

On the opening day the women joined the men at the hotel for luncheon at which the featured speaker was General Jacob L. Devers. Later the same afternoon a delightful Tea Dance was held in the Georgian Room of the hotel. This especially successful affair was enjoyed particularly by the many young service men who attended the men's meeting.

The annual business meeting convened Tuesday forenoon at 10:30 in the Ohio Room of the hotel with Mrs. Rudolph F. Gagg, president, presiding. Alex D. Bailey, president of the A.S.M.E., and D. Robert Yarnall, president-elect, were guests at the meeting. Both spoke appreciatively of the Auxiliary and commended it particularly on the aid it was able to offer young engineering students through loan and scholarship funds.

The treasurer, Mrs. Charles E. Gus, reported a balance in the general fund of $503.04; Student Loan Fund, $7,514.35, ($3000 of this is in Government War Bonds); Calvin W. Rice Memorial Scholarship Fund, $557.68. This year's award of the Scholarship is $500.

The following officers for 1946 were elected: President, Mrs. J. Noble Landis; first vice-president, Mrs. Justin J. McCarthy; second vice-president, Mrs. Earl B. Smith; third vice-president, Mrs. D. K. Wright; fourth vice-president, Mrs. P. M. King; fifth vice-president, Mrs. F. M. Farmer; treasurer, Mrs. Charles E. Gus; corresponding secretary, Mrs. L. W. Bennett; and recording secretary, Mrs. R. B. Purdy.

Mrs. F. W. Gibson, chairman of the Student Loan Fund, reported that with the return of many young men to the colleges of the country, the Committee was prepared for an increase in requests. The committee is in correspondence with all of the students holding loans; most of them repay at regular periods.

Mrs. J. Noble Landis, chairman of the Calvin W. Rice Memorial Scholarship Fund, reported on the recipient of the award for the coming year—Mr. Nelson Pereira, of Chile, who will study mechanical engineering at Purdue University.

Reports were presented by the chairmen or sponsors of all the Sections. In spite of the demands of war work upon women, the Sections have all held regular meetings throughout the year and have contributed generously to both our Funds.

Following the business meeting, the Annual Luncheon was held in the Engineering Woman's Club, with music, a talk on hobbies, and bridge occupying the afternoon. In the evening the women again joined the men at the reception and dance of the Annual Dinner and Honors Night.

Wednesday was devoted to a luncheon at the Hotel Woodstock and a visit to the beautiful Jumel Mansion, now a museum. The program on Thursday was on India, with lectures, a visit to a Buddhist temple, and an Oriental luncheon providing an unusual conclusion to the Annual Meeting.

The Auxiliary deeply regrets the death of Mrs. A. H. Kingsbury, whose gracious personality endeared her to the members through the many years of her association with the organization—Mrs. C. H. Kent, *Chairman, Publicity and Printing.*

AT THE TEA DANCE MRS. RUDOLPH F. GAGG (SITTING), OUTGOING PRESIDENT OF THE WOMAN'S AUXILIARY SERVES TEA

Index of CIOS Reports Available

THE Office of the Publication Board, Department of Commerce, Washington 25, D. C., has issued the first index on industrial and scientific reports released by the Army and Navy. This is the first group of Combined Intelligence Objectives Subcommittee (CIOS) reports which have been declassified for distribution to industry.

President's Page

THE Annual Meeting, which is reported elsewhere in this issue of MECHANICAL ENGINEERING, was a profitable occasion for the more than 4000 of us who were fortunate enough to be able to attend. Transportation easing permitted a late decision to change the meeting from merely a business meeting with a few technical sessions under the auspices of the Metropolitan Section into a full-fledged Annual Meeting with all the sessions and committee meetings. Despite this late decision, the technical program equaled meetings of the past in richness of content and interest of attendants.

To the 240 authors who contributed from their experience to make the meeting notable, and to the Professional Divisions and Committees who arranged the technical programs, the Society is deeply grateful. The quality of our papers and discussions is one attribute that makes our Society great and it is gratifying to record that despite the confusions of the past months the quality of the papers met a high standard.

We congratulate President Bailey on his fine leadership and good humor at the Annual Dinner which was planned and carried through with dignity and satisfaction to members and guests.

The new year is now upon us; our Society's course has been charted; the eight newly elected Vice-Presidents attended the Annual Meeting and with them we have discussed important problems and for them we bespeak the full co-operation of committees and membership in their districts.

May 1946, our first full year of peace, be a year of constructive progress.

D. ROBERT YARNALL, *President*, A.S.M.E.

Suggestions for 1946 Officers Requested by Nominating Committee

THE 1946 National Nominating Committee of the Society at the June 17–21, 1945, meeting in Chicago, Ill., selected H. E. Martin as chairman and W. W. Babcock as secretary.

An informal meeting was held at the Annual A.S.M.E. meeting in New York, N. Y., on November 29, 1945.

There will be two formal meetings of the Committee. The first of these meetings will be held Feb. 15, 1946, in Augusta, Ga. The final one will be held during the Semi-Annual Meeting of the Society in Detroit in June, 1946.

Proposals by Individual Members Welcomed

Proposals from any member for candidates for the offices to be filled will be welcomed by the Committee, and members are urged to submit the names of candidates and their records at an early date. The record should be submitted on the proposal form prepared by the Committee. Before submitting the name of a candidate, his consent to serve should be obtained by the proposer. The proposer, not the candidate, should fill out the form.

Proposal forms may be obtained from any Member or Alternate of the Nominating Committee as listed below.

The completed forms should be sent to the Secretary of the Nominating Committee, W. W. Babcock, Central Illinois Light Company, 316 S. Jefferson St., Peoria, 2, Ill.

Offices to Be Filled

President	To serve 1 year	
Vice-President	To serve 1 year	Region I
Vice-President	To serve 2 years	Region II
Vice-President	To serve 2 years	Region IV
Vice-President	To serve 2 years	Region VI
Vice-President	To serve 2 years	Region VIII
Directors at Large (2)	To serve 4 years	
Directors at Large (2)	To serve 2 years	

In accordance with B7-Par. 9 of the Society's Constitution "Candidates for the office of President, Vice-President, and Directors at Large shall be of the Grade of Fellow or Member of the Society."

Early Action Requested

The Nominating Committee urges that proposals be sent in early, if possible, by April 1, 1946. This will give the Committee more time for full consideration.

1946 National Nominating Committee

Group I

J. W. Zeller, Northeastern University, 360 Huntington Ave., Boston, Mass.
W. K. Simpson, *1st Alternate*, 9 Sands St., Waterbury 30, Conn.
L. J. Hooper, *2nd Alternate*, Highland Ave., Holden, Mass.

Group II

H. E. Martin, *Chairman*, Babcock & Wilcox Company, 85 Liberty St., New York, N. Y.
J. H. Sengstaken, *1st Alternate*, Western Precipitation Corporation, 405 Lexington Ave., New York, N. Y.
A. Ehbrecht, *2nd Alternate*, Gries Reproducer Corporation, 780 E. 133rd St., New York, N. Y.

Group III

A. R. Smith, General Electric Company, Schenectady, N. Y.
C. E. Miller, *1st Alternate*, Office of chief engineer, 21st and Virginia Ave., Washington, D. C.
R. C. Dannettel, *2nd Alternate*, Consolidated Gas Electric Light & Power Co., Baltimore, Md.
W. H. Chaffee, *3rd Alternate*, 801 St. Marks Ave., Westfield, N. J.

Group IV

P. R. Yopp, 3509 Piedmont Rd., Atlanta, Ga.
Neil Brown, *1st Alternate*, 1117 Liberty Life Building, Charlotte, N. C.
J. B. Jones, *2nd Alternate*, Virginia Polytechnic Institute, Box 205, Blacksburg 3, Va.
H. G. Mouat, *3rd Alternate*, Whiting Corporation, 544 Martin Bldg., Birmingham, Ala.

Group V

E. J. Martin, Procter and Gamble Co., Ivorydale, Ohio
F. H. Vose, *1st Alternate*, Case School of Applied Science, 10900 Euclid Ave., Cleveland, Ohio
W. D. Sheldon, Jr., *2nd Alternate*, Sheldon Ltd., Galt, Ont., Canada

Group VI

W. W. Babcock, *Secretary*, Central Illinois Light Co., 316 S. Jefferson St., Peoria 2, Ill.
Prof. H. O. Croft, *1st Alternate*, Univ. of Iowa, 122 Engineering Bldg., Iowa City, Iowa
F. P. Shannon, *2nd Alternate*, Henry Vogt Machine Co., 10th & Ormsby St., Louisville, Ky.

Group VII

Ralph L. Dyer, 812 Insurance Bldg., Seattle, Wash.
Fairman B. Lee, *1st Alternate*, 117 Garfield St., Seattle 4, Wash.

Group VIII

H. R. Hughes, Jr., W. R. C. Smith Publishing Co., 1341 Liberty Bank Building, Dallas 1, Texas
L. J. Cucullu, *1st Alternate*, New Orleans Public Service, Inc., 317 Baronne St., New Orleans, La.
O. L. Lewis, *2nd Alternate*, Jones & Laughlin Supply Co., 108 N. Trenton, Tulsa, Okla.

T. A. Marsh Presented Percy Nicholls Award for 1945

THE Percy Nicholls Award for 1945 was presented to Thomas A. Marsh, member A.S.M.E., manager, Corporation Sales, Iron Fireman Corporation, Cleveland, Ohio, on Nov. 27, 1945, at the Annual Luncheon Meeting of the Fuels Division of The American Society of Mechanical Engineers held in connection with the 1945 A.S.M.E. Annual Meeting. The award was presented by W. G. Christie, member A.S.M.E., chairman of the award committee.

In accepting the award Mr. Marsh spoke

T. A. MARSH

briefly of some of his experiences in the fuel-burning field and of his acquaintance with and admiration for the late Percy Nicholls.

The Citation

The Percy Nicholls Award was instituted by the Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining and Metallurgical Engineers and is presented "for notable scientific or industrial achievement in the field of solid fuels." The citation of the award presented to Mr. Marsh read as follows:

"In recognition of the outstanding achievement of Thomas Alfred Marsh in the field of solid-fuel engineering, the Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining and Metallurgical Engineers extend to him the congratulations of his fellow engineers and confer upon him the Percy Nicholls Award for 1945.

"His contributions to scientific methods of buying, selling, sizing, and utilizing coal have been noteworthy and of outstanding merit. His development and application of mechanical equipment to take the best advantage of the laws of combustion have aided materially in developing coal-burning plants to their present high state of efficiency.

"He has given freely of his time and energy in disseminating the special knowledge he acquired by active participation in the work of technical and trade societies. His contributions to the technical and practical literature of the art of fuel engineering have been widely used.

"His advice has often been sought and given without stint. His recommendations have been timely and helpful. His predictions of trends and developments in solid fuel burning have been exceptional.

"In him we recognize an inspirational leader, an able engineer, a boon companion, and a friend."

The certificate of award was signed by Larry A. Shipman, chairman, A.I.M.E. Coal Division, and O. F. Campbell, chairman, A.S.M.E. Fuels Division.

A.W.S. Issues Instructions for Arc-Welding Operators

IN 1939, the American Welding Society organized a Committee on Minimum Requirements of Instruction for Welding Operators to prepare suitable training standards for vocational courses in welding.

In July, 1942, "Part A—Arc Welding of Steel 3/16 to 3/4 In. Thick," the first in the series, "Code of Minimum Requirements for Instruction of Welding Operators," was issued and found wide use in the training of welding operators for war production.

The Committee has studied the use of Part A and, based on the experience reported, as well as experience gained by the Committee in subsequently preparing "Part B-1—Oxy-Acetylene Welding of Steel-Aircraft," a revision of Part A was undertaken to make it most applicable to the postwar training of welding operators, including returning veterans.

The revision embodies primarily a modification of the manner of presentation, although some changes in the exercises and lecture information have also been made to provide for a more inclusive course.

Part A, in addition to prescribing equipment and facilities of the school, exercises for each position of welding, and topics for lecture and discussion, contains nine appendixes intended to be of aid to the individual student as well as the schools. Topics covered include: Design of positioning equipment; design and use of testing apparatus; welding electrodes; suggested exercises; and annotated bibliography of publications relating to arc-welding.

Copies of "Part A—Arc Welding of Steel 3/16 to 3/4 In. Thick" may be obtained from the American Welding Society, 33 West 39th Street, New York 18, N. Y.

SPI Issues Classification of Plastics Molding Materials

THE Society of the Plastics Industry, Inc., has just issued a classification of plastics molding materials which is aimed to provide data comparable to that which has been available to those employing wood, metals, and other materials in their operations. It presents in chart form a guide to the various properties of plastics molding materials as established by the material makers and molders. Both thermosetting and thermoplastic materials are included and values shown for their mechanical, electrical, optical, thermal, chemical, and aging properties.

Copies of the classification chart and explanation are available now upon request to The Society of the Plastics Industry, Inc., 295 Madison Avenue, New York, 17, N. Y.

Louisiana Engineering Society to Meet Jan. 10–12

THE annual meeting of the Louisiana Engineering Society will be held at the St. Charles Hotel, New Orleans, La., Jan. 10–12, 1946. The keynote of the meeting will be industrial reconversion.

Petroleum Committee of A.S.M.E. Holds First Technical Sessions

THE reorganized Petroleum Committee of A.S.M.E. held its first technical sessions on November 29, 1945, as a part of the Annual Meeting. The morning and afternoon sessions were well attended, bearing out the contention of the new committee that there is a definite interest in this field on the part of our members. Four papers were offered during

AT THE SPEAKERS' TABLE, PETROLEUM DINNER

(*Left to right:* William Raisch and Robert E. Allen.)

these sessions which in each instance were followed by lively discussion. A luncheon of the executive members took place, and in the evening a dinner, open to all members and their friends, was held with Mr. Robert E. Allen, Director of Information of the American Petroleum Institute, as the speaker. All members of the Society are encouraged to enroll with the committee if they are interested in petroleum or its related activities.

WILLIAM RAISCH, *Chairman*,
Petroleum Committee, A.S.M.E.

United Engineering Trustees Report for 1944–1945

Summary of Facts Concerning Finances, Building, Engineering Societies Library, and Engineering Foundation

THE Annual Report of the United Engineering Trustees, Inc., for 1944–1945 was issued on October 25, 1945, by president F. M. Farmer. Mr. Farmer's report in somewhat abridged form follows:

Forty-First Year

This Annual Report covers a year which will forever be conspicuous on the calendar of time as the last year of a war which has been by far the most widespread, the most destructive, and the most costly in lives in all history. The abnormal conditions made necessary by the war have seriously affected all of our activities, personnel, business, and association. The emergency wartime controls over men and materials, the effect on members of our Founder Societies in the national service, the uncertainties which always follow a war in the reconversion from war to peace conditions—all of these things affect our operations and our thinking. Now that the war is over and the vital part which the engineering profession has had in its successful prosecution is generally recognized, it may be anticipated that thought and attention will again be given to matters which are the common concern of engineers.

The Board of Trustees of UET, Inc., has, as usual, kept in close contact with the affairs of the organization and its normal routine operation. Much special attention has been given to the problem of larger and more modern quarters for the Founder and Associate Societies.

Engineering Societies Building

The matter of inadequacy of the 39-year old Engineering Societies Building to meet the present-day requirements of our Societies, both as to quantity and quality of space, was discussed at some length in last year's report. The present building, despite its age, is in good physical condition as attested by insurance inspection reports. It is simply inadequate to meet the requirements of the Founder and Associate Societies now in the building or who would be in the building if space were available.

During this last year urgent appeals for specific amounts of additional space for three of the Founder Societies, and the urgent needs of the Library, have greatly emphasized this problem and consequently it has been receiving major attention by the Board. A committee of the Board made a preliminary exploration of the various alternatives, including revamping the present building, acquiring adjacent property, and a new building on a new site. The Board then retained the services of a firm of consulting engineers, a firm of architects, and a firm of real-estate experts to investigate jointly these various alternatives and render a professional report with recommendations. It is expected that this report will be available before the end of the year.

Naturally the financing of any such project has been prominent in the Board's discussions. Several of the smaller associated societies have recently raised substantial funds for their own individual buildings. However, we have been assured that these organizations will be interested in any early plans which may be developed for a *real engineering center* in which they might be included and toward which they might contribute. The participation of other societies in the financing of an Engineering Center Building would of course require changes in the United Engineering Trustees, Inc., organization to provide for additional corporate members.

Financial Matters

Investments. The continued efforts of the Finance Committees over the past several years to improve the quality of the corporation portfolio (including the gift funds for the benefit of the Library and the Foundation, and the other custodian funds) have enabled our Committee of the past year, with the assistance of our professional financial advisers, to replace with top-grade investments practically every security which had deteriorated, and to maintain an encouraging rate of income for our departments.

Operations. The accompanying statement for the year covering costs of operating the building and the corporation shows a credit balance of $2,171.86, which compares with a credit of $286.70 for the previous year. This credit reflects principally the greater use of meeting halls than was anticipated a year ago and close attention to expenditures. It is to be specially noted that this result was accomplished in spite of the higher cost of maintenance materials and the increases in wages of building-service employees ordered by the War Labor Board during the year.

In connection with this statement, the allocation to which attention was called in last year's report should again be noted, namely, roughly 16 per cent of the total assessments paid by the Founder and Associate Societies goes to the Engineering Societies Building Depreciation Reserve Fund, 62 per cent to operating the Engineering Societies Building, and 22 per cent to operating United Engineering Trustees, Inc.

Building Depreciation Reserve Fund. Accretions to the Depreciation Reserve Fund for the Engineering Societies Building have continued, the Fund having increased during the year by $20,000 from income and by $12,376.59 from interest, so that at the end of the fiscal year the fund amounted to $546,273.91. The General Reserve Fund, authorized in November, 1914, to be maintained at $10,000 has been called upon at various stages, and always restored. During the past year it has been $1,500 with $6,000 added at the end of this year, bringing it to $7,500 now. It should be restored as rapidly as possible to at least $10,000 against emergency.

Audit. All accounts have been audited as usual by the accounting firm of Haskins and Sells; their certificate verifies the correctness of our books and all transactions.

The aggregate book value of our capital-fund investments on September 30, 1945, the close of the fiscal year, was $1,606,249.46 with a market value on or about that date of $1,712,211.99 or 106½ per cent of book value. This percentage for the preceding annual period was 101½ per cent.

Fiduciary Functions. The Corporation continues to act as treasurer for Engineers' Council for Professional Development and as custodian of the Engineering Societies Personnel Service, Inc., Relief Funds, the funds of the John Fritz Medal Board of Award, the funds of the Daniel Guggenheim Medal Board of Award, and of the funds contributed from outside sources for the support of research directed by the Engineering Foundation.

Engineering Societies Library and Engineering Foundation

The Directors of these departments of the Corporation have prepared detailed reports of their activities which are included in the pages which follow.

The Future

It has been recognized during the recent years that this is an age of science, engineering, and technology. It now appears to be generally conceded that these fields of man's activities will play a much more prominent part in the great economic progress which is being so widely anticipated in the immediate future. Thus engineers, scientists, and technologists will have a more prominent role in the country's industrial and business affairs. The number of societies will increase and their memberships will grow. The need for coordination will steadily increase among these groups in dealing with nontechnical matters of common concern, such as the collective-bargaining problem and legislation involving engineers and engineering questions.

The engineering profession should present a united and forceful front in dealing with such matters. Should not the Trustees, in planning for the increased physical facilities that will be required, provide not only a real Engineering Center Building which can house all the principal societies in the engineering fields, but also plan to serve the engineering professions in dealing with these matters of common concern through assisting in the organization of the required agencies and by providing the necessary headquarters and facilities for them? In other words, in addition to simply administering the Engineering Societies Building, help to carry out in other ways the object of the Corporation as stated in its Charter, namely, "the advancement of the engineering arts and sciences in all their branches."

Conclusion

The cordial interest and continued support of the members of the Board of Trustees, and

their attendance at the meetings of the Board and its committees have been most helpful and is greatly appreciated, as is the honor of electing me to this office for this second term.

On behalf of the Board, thanks are extended to the Secretaries of the Founder Societies and their staffs for their excellent co-operation at all times in our mutual problems.

Engineering Societies Library

IN his annual report to the Library Board, Harrison W. Craver, director, Engineering Societies Library, New York, N. Y., stated:

The cessation of hostilities came so late in the year that it had little effect on the work of the Library which continued at last year's high level of activity. Services rendered this year include: photostat orders 4211; photostat prints 53,143; telephone inquiries 5557; borrowers, 1156; books lent 1632; searches and copies 106; translations 65; and letters written, exclusive of those concerning book orders, 2051. Some of these figures are larger and some are slightly smaller than those for the preceding year but all are nearly the same. Within the past month military use has practically ended and it may be supposed that civilian use will increase as engineers return to civil life and normal pursuits.

Visitors served this year numbered 19,712 and nonvisitors 13,205. Use of the Library by telephone and mail has grown from fifteen per cent in 1924, to thirty per cent in 1940, to forty per cent in the present year. This increased use by nonvisitors may be partly attributable to lack of time to visit the Library during the war years but it seems more likely that the increased use of our services by mail and telephone is due to a gradually widening knowledge and appreciation of the services and resources that we offer them without requiring a personal visit. Requests from nonvisitors cover a wide variety of matters—the loan of specific books, advice as to the best or most recent books in various fields, inquiries as to sources of information, specific data on manufacturing problems, and letters from foreign countries asking for help of all kinds. To answer these courteously and intelligently calls for constant exercise of judgment and they cannot be delegated to junior staff members. On the average each of these requests requires much more library-staff time than would be needed if the inquirer came to the Library.

Book loans have risen from 580 in 1940, to 1632 in the current year. The work involved is serious, for most requests leave book selection to us, the usual form being "the best book on this subject" or "a book that describes the design of . . . . . ;" this calling for judgment on the part of the staff.

Problems

Three pressing problems face us. One is that the stack space for book storage is entirely full, so that every added book creates a difficulty. By erecting additional stacks on the fourteenth floor, room for 20,000 volumes can be obtained, which would postpone matters for perhaps three or four years. No other space is available for future expansion beyond this, and even this addition will leave little if any space for the handling of gifts. Unless a new building with greatly enlarged capacity is available by then, additional storage will have to be provided outside this building, or the Library cut down in size by discarding books of lesser value, with danger of reducing its usefulness.

Another matter of grave importance is the need for greater income. Costs of all operations are rising rapidly. Prices of books and periodicals are advancing, binding costs as well, and it is no longer possible to obtain librarians at the salaries that have ruled in the past. Salary increases should be made for some staff members who have long service records.

The time is approaching when some members will no longer be able to continue working. Salaries have not been large enough to permit sufficient savings for old age. As employees of a nonprofit organization, they do not come within the provisions of the Social Security laws. Some plan for retirement should be established at an early date.

These three matters need your serious attention at once.

The inability to get books and periodicals from Europe during the past five years will call for much effort as normal communications again become possible. Several years will probably pass before the gaps in periodical sets are filled, as many publications have been issued irregularly and in limited editions.

The money that would normally have been spent for acquiring European publications, for binding, and for buying needed new and replacement equipment has been set aside as a reserve fund, to be spent in the near future for making good such deferments. Another sum has been similarly set aside as a reserve to replace Service Bureau equipment.

Personnel

As Secretary of the American Society of Civil Engineers, Mr. George T. Seabury had been an ex-officio member of the Library Board since 1925. His death, on May 25, 1945, just as he ended his term of office, made the loss seem doubly sad. Always keenly interested in the Library, he contributed in many ways to its advancement. He will be greatly missed.

On July 16, 1945, Mr. Ralph H. Phelps joined the staff as assistant to the Director.

General

The Japanese-English technical glossary that was begun before the war, and financed by a grant from the Rockefeller Foundation, was presented to the United States Government in April, 1945.

Acquisition

During the year 9293 volumes, pamphlets, maps, etc., were received. Of these 5396 were added to the Library. The remainder, being duplicates or works of no value to us, were given to other libraries or reserved for sale or exchange as opportunity arises.

The total resources at the close of the year, were 160,030 volumes, 9112 maps, and 4712 searches, a total of 173,854 items.

During the year a large number of gifts were received. The list is too long for insertion here, but mention may be made of gifts from Messrs. M. N. Baker, John T. Boyd, David Greenhood, J. M. Juran, Donald M. Liddell, W. V. N. Powelson, Edy Velander, and Mrs. C. M. Weld. Other donors included the Chemists' Club, Crocker and Ryan, the Institute of Radio Engineers, the McGraw-Hill Publishing Company, Inc., the Michigan University Law Library, the St. Joseph Lead Company, and the Society of Automotive Engineers, the administrators of the estates of Bela Low and R. S. MacElwee also presented valuable material.

Our sincere thanks are extended to these and the many others who enriched our collection.

Finance

The budget for general operation was $52,200 of which the following amounts were provided by the Founder Societies on a membership basis:

American Society of Civil Engineers	$10,675.40
American Institute of Mining and Metallurgical Engineers	8,414.60
American Society of Mechanical Engineers	10,096.40
American Institute of Electrical Engineers	11,149.10
	$40,335.50

Expenditures amounted to $45,153.55 of which $4,970.83 was spent for books, periodicals, and other equipment of permanent value.

Service Bureau receipts were $39,108.70 and expenses were $31,735.49.

The Engineering Foundation

IN their annual report to the United Engineering Trustees, Inc., A. L. Queneau, chairman, and E. H. Colpitts, director, of The Engineering Foundation, stated:

The Engineering Foundation, established in 1914, completed its thirty-first fiscal year on September 30, 1945.

The financial statement summarizes the present capital funds of the Foundation, and the income and expenditures during the year. The book value of the capital funds of the Foundation on September 30, 1945, was $984,650.00 as compared with $962,000.00 on September 30, 1944. The income for the fiscal year, 1944–1945 was $34,536.89 as compared with $35,472.76 for the previous year 1943–1944. For the fiscal year 1944–1945 disbursements amounted to $28,675.22 as compared with $22,750.78 for the year 1943–1944. The balance on September 30, 1945, was

$46,876.54 as compared with $41,014.85 September 30, 1944.

The Foundation has supported, during the year, a number of research projects in diverse fields of engineering and also certain agencies having as their objective the advancement of the engineering profession. As in the past, preference has been given to projects of a fundamental nature which would not normally be undertaken by an industrial research organization; otherwise where a group of industries are concerned the Foundation has merely furnished such support as enabled it to serve as a catalyzing agent for the project whose main support was from industry. Projects have been scrutinized as to their bearing on the war effort. In some cases certain parts of a research on a project supported by the Foundation became of specific interest to the war effort and those parts of the problem were taken over or further supported by a Government agency. That is, the Foundation's support of certain broad research projects led to more specific projects which the Government could support.

The demand continued throughout the year for competent research personnel to serve in the war agencies of the Government and in industries supporting the war effort. As a consequence, progress on one or two projects has been retarded.

The adequacy of the Foundation's resources to support a research program cannot be judged by demands made over the last four years. Industry will, no doubt, under conditions of reasonable prosperity, support extensive research largely in company laboratories. The Army and Navy seemingly will continue research in fields basic to a state of continued preparedness. To support research of a more general interest and of a scope differing from the above, organizations such as the Foundation can play an important part, but to do this additional funds are necessary.

During the year 1944–1945 work under eight projects has continued and these are covered in the accompanying technical report. For the year 1945–1946 grants were recommended for continuation of nine projects and for the initiation of two new projects.

The following projects are those in which the A.S.M.E. is particularly interested:

Research Committee on Metal Cutting Data and Bibliography. Project 63.

Chairman, M. Martellotti, research engineer, Cincinnati Milling Machine Company, Cincinnati 9, Ohio.

This project involves assembly in a form useful to industry of material hitherto available only in scattered form in the literature. The activities of the year have included:

Manual on Cutting of Metals. The major activity of the committee has centered on the revision of the "Manual on the Cutting of Metals." Progress on the revision of the Manual has been affected by present emergency conditions which have prevented members of the committee, who have volunteered the compilation of the material, to devote more of their time to this work. The following chapters, however, have been completed: Part 1, Chapters 1, 2, 3, and 7; Part 3, Chapters 1, 2, 3, 4, 5, and 6.

Material for other chapters is now being compiled.

Bibliography on Cutting of Metals. This has been completed. The volume, as a companion book to the "Manual on Cutting of Metals," has been added recently to the Society's publications and is available to all those interested in this subject.

Meetings of the Society. The following meetings were sponsored by the committee:

Annual Meeting, 1944, in New York, N. Y. —3 sessions (ten papers)

Semi-Annual Meeting, 1945, in Chicago, Ill, —2 sessions (six papers).

As to future plans, it may be noted the Committee has in preparation a Manual of Drills and Drilling, for which part of the material is available and additional material is being compiled.

Plastic Flow of Metals. Project 68.

Chairman, Dr. A. Nadai, Westinghouse Research Laboratories, East Pittsburgh, Pa.

During the year activity continued upon a number of more specific research projects, two of which, supported in part by the Engineering Foundation, can be reported upon. Other projects closely allied in subject matter were supported by Government funds and results obtained are confidential.

Project No. 1. Investigation on the Friction at Extreme Pressures and at High Temperatures. Work on this investigation started on June 1, 1943, under the supervision of the chairman of this committee at the Westinghouse Research Laboratories. The object of this investigation was to furnish, by experiments, the values of the friction between metals under extremely high pressures at normal and at elevated temperatures. Experiments on solid friction at normal temperature were carried out by S. J. Dokos, research engineer, until February 23, 1945, when Mr. Dokos left his position in Pittsburgh, Pa., to accept a new position at the South Philadelphia Works of the Westinghouse Electric Corporation. Mr. Dokos observed friction values under a sliding contact for various metals at normal temperature in the absence of any lubricants. In these tests a machine was used which had been especially developed for this purpose during the year 1943, in which a cylindrical contact piece is sliding on a revolving disk. Two distinct types of solid friction were observed. At velocities less than a certain critical value intermittent "stick-slip" friction was recorded. Above this critical velocity, uniform friction was observed. Conditions under which these types of friction appear were carefully investigated. The results of this series of tests were reported in Research Report SR-293, dated February 21, 1945, entitled "Solid Friction Under Extreme Pressures—Part I," submitted by S. J. Dokos. Copies of this report were submitted to the members of the committee, to five companies of the oil industry which had contributed funds to this investigation during the preceding fiscal year, and to C. B. LePage. The committee recommends publication of this report through the A.S.M.E. in the *Journal of Applied Mechanics.*

Project No. 2. Investigation on Stress-Strain Relations in Various Drawing Processes. This project was continued during the year at Case School of Applied Science under direction of Dr. G. Sachs. It appears that during the period from March to July, 1945, inclusive, only a small amount of work was carried out on this project, due to the extensive war work in which the laboratory was engaged. Some experimentation was continued, and a publication on the first phase of this work will be ready in December, 1945, covering the forces and stresses required to draw copper, steel, and possibly brass tubing, and the possible reductions for various conditions of die contour and lubrication. The recent tests on steel tubing have shown that the reduction is practically independent of die angle and type of lubricant, indicative of equal frictions on both the outer and inner surfaces of the tubing.

The general theory of drawing thin-walled tubing with roller dies has been developed. Some additional work, however, will be required to prepare the fundamental solution for a report; while it would be necessary to carry out extensive numerical calculations to illustrate the effects of the pertinent variables.

Strength of Metals (Mechanical Springs). Project 85.

Chairman, J. R. Townsend, Apparatus Materials Engineer, Bell Telephone Laboratories, Inc., New York 14, N. Y.

The particular project to which the Foundation contributed partial support covered completion of a book on "Strength of Metals," by Dr. D. J. McAdam, Jr., and R. W. Clyne of the Bureau of Standards. Progress has been made and it is expected that the completed volume will be ready for publication sometime during the first six months of 1946.

The American Steel Foundries has supplemented other funds and support available by a contribution of $2500 to this project.

Fluid Dynamic Problems. Project 86.

Chairman, W. R. Elsey, Pennsylvania Railroad, Philadelphia, Pa.

This project covered the preparation of manuscript for a book presenting the fluid dynamic problems of turbines and compressors to be prepared by Prof. John R. Weske of Rennselaer Polytechnic Institute, Troy, N. Y.

Due to pressure of research work relating to the war effort very little progress has been made by the author on this project, but it is expected work can now be resumed.

Engineers' Council for Professional Development. Project 56, Various Committees.

Chairman, Everett S. Lee; *Secretary*, S. L. Tyler.

The activities of the Engineers' Council for Professional Development, referred to as E.C.P.D., have in large part been through the agency of various committees:

1 *Committee on Student Selection and Guidance. Chairman*, Dr. A. R. Cullimore.

The scope of this committee's activities included two principal projects.

The outstanding research project sponsored by this committee is the Measurement and Guidance Project in Engineering Education which has been carried on by Dr. K. W. Vaughn of the Carnegie Foundation for the Advancement of Teaching, and from which Foundation substantial financial support has been granted.

This committee has continued to operate through the high schools, employing among other methods circulation of "Engineering as a Career." This activity becomes particularly useful in helping the war veterans, as the committee feels a large share of their help comes from high-school groups.

2 *Committee on Engineering Schools*, Dr. D. B. Prentice, *Chairman*.

The Committee on Engineering Schools has continued its work of accrediting under present conditions and looks forward to renewed activities as new conditions unfold.

The program for the accrediting of technical institutes has been progressed by Dean H. P. Hammond and his subcommittee to the point where regional committees have been set up completely throughout the United States of America, and actual accrediting will start soon.

3 *Committee on Professional Training*, Dr. Charles A. Pohl, *Chairman*.

The Committee on Professional Training has been finding it quite difficult to carry on its activities as so many of the younger men have been involved in the Services. Nevertheless, the committee has been active and has kept the group together so that, as new opportunities unfold it will be able to progress them.

4 *Committee on Professional Recognition*, Dean N. W. Dougherty, *Chairman*

This committee has continued its study and consideration of a number of matters which relate to standardization and definition of terms determining the status of an engineer.

5 *Committee on Employment Conditions for Engineers*, Van Tuyl Boughton, *Chairman*.

The Chairman's report continues to give a résumé of what is happening in this field and provides factual matter for any further action.

6 *Committee on Principles of Engineering Ethics*, Dr. Dugald C. Jackson, *Chairman*.

The committee is still progressing the work to obtain a Canons of Ethics and although there are many different thoughts, there is a prospect that unanimity is coming into being.

7 *Committee on Information*, George A. Stetson, *Chairman*.

The Committee on Information has carried on its regular work and in addition has initiated a listing of the engineering organizations in the country for the Subcommittee on the Organization of the Engineering Profession, H. V. Coes, *Chairman*, of the Joint Conference Committee of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Chemical Engineers. With funds provided by the Joint Conference Committee, J. G. Kneiling, a young engineer, has been employed to carry on the work of preparing the lists under the direction of the committee.

National Research Council

Office of Scientific Personnel, Project 83, National Academy of Sciences, Washington, D. C.

Dr. Henry A. Barton, *Chairman*, Committee on Scientific Personnel.

Dr. M. H. Trytten, Director, Office of Scientific Personnel.

This office has been extremely active during the year 1944–1945, first, in securing for or recommending to Federal Agencies scientific and technical personnel peculiarly fitted to fill important posts, and, second, by serving in a more or less intimate advisory capacity to those Federal agencies on wartime policies and problems, particularly those relating to the training, placement, and utilization of scientific personnel. With the end of hostilities the nature of the problems presented to the Office have changed and pressing matters concerned with immediate postwar years are receiving attention. In more general terms the Office has continued to serve as a listening post and informal mouthpiece for science in matters of public interest developing in Washington in which either scientists can contribute valuable counsel or the capacity of science to serve the nation is materially affected.

For the information of those concerned with or influential in policy-making the Office has continued to publish bulletins and other material. Twenty-two bulletins have been issued during its operation of about five years and others may issue in the near future. Of particular interest the following of recent issue are mentioned briefly:

The Director, in an address at the fall meeting of the Middle States Association of Colleges and Secondary Schools reprinted in the *Scientific Monthly*, presented arguments showing the imperative necessity for the maintenance of an adequate supply of highly trained personnel, whether in peace or in war. The Director indicated that recognition of this necessity had been flagrantly missing in American policy. The article included data showing a serious deficit of scientists trained to the highest level for the postwar years. About 2000 reprints of this article were requested and its circulation was extensive among persons in position to influence public thought.

Relating somewhat to the above matter, an Office of Scientific Personnel Bulletin, No. 22, was issued in co-operation with the American Council on Education. This bulletin presented information available for predicting the postwar supply and demand for highly trained personnel in a number of fields, such as the health sciences and technological sciences. This bulletin was distributed to the combined mailing lists of these two organizations, and to the officers of the scientific societies affiliated with the American Association for the Advancement of Science, as well as to a wide selection of Government officials and agencies, including the War Manpower Commission. It is too early to predict how the information contained in this bulletin will influence legislation and the procedures of various Government agencies, but the problem has been brought sharply to the attention of the Government and of the public.

In this same connection of conserving scientific personnel the Office has continued to concern itself actively with Selective Service policies.

As a practical measure looking toward supplementing the number of trained scientific personnel envisaged as required in the future the Office prepared a proposal for a Rockefeller Foundation Fellowship fund to be administered by the National Research Council. This proposal, after approval by the Research Council, was presented to the Rockefeller Foundation and a grant of $335,000 was made. A committee of the Council has been set up to govern the awarding of these fellowships and will no doubt be prepared to make such awards when candidates find it possible to accept them.

The Office continues its contacts with the War Department. Recently, for example, it was called upon to help in finding suitable technical personnel to be assigned to training activities under the War Department in the European theater during the period the Army will be substantially represented there.

Likewise, the Office has continued to cooperate with the Navy Department.

Among other Government agencies with which the Office has maintained contact on personnel problems are the Veterans Administration, the Office of Education, the State Department's Division of Cultural Co-operation, and the Council of Personnel Administration.

While the Office of Scientific Personnel was created to meet the needs of the war years, it is clear that thought should continue to be given to problems and policies affecting scientific personnel.

A.S.H.V.E. Announces 52nd Annual Meeting

THE Council of the American Society of Heating and Ventilating Engineers has announced that the 52nd Annual Meeting of the society will be held January 28–30, 1946, in New York, N. Y., with headquarters at Hotel Commodore.

Officers Nominated

Those nominated for office are: For president, Alfred J. Offner, consulting engineer, New York, N. Y.; first vice-president, Dr. B. M. Woods, member A.S.M.E., University of California, Berkeley, Calif.; second vice-president, G. L. Tuve, member A.S.M.E., Case School of Applied Science, Cleveland, Ohio; treasurer, J. F. Collins, Jr., secretary-treasurer, National District Heating Association, Pittsburgh, Pa.

Those nominated to serve as members of council for a three-year term are: Earl G. Carrier, Carrier Corp., Boston, Mass.; F. W. Hutchinson, Purdue University, Lafayette, Ind.; R. A. Sherman, member A.S.M.E., Battelle Memorial Institute, Columbus, Ohio; and M. S. Wunderlich, member A.S.M.E., Minnesota and Ontario Paper Co., Minneapolis, Minn.

Members nominated to serve for a three-year term on the Committee on Research are: L. N. Hunter, member A.S.M.E., National Radiator Company, Johnstown, Pa.; C. O. Mackey, Cornell University, Ithaca, N. Y.; R. D. Madison, member A.S.M.E., Buffalo Forge Co., Buffalo, N. Y.; L. G. Miller, Michigan State College, East Lansing, Mich.; and L. P. Saunders, Harrison Radiator Division, General Motors Corp.

A.S.M.E. NEWS

the General Electric Company gave "A Report on a Military Science Mission to Germany for the U. S. Government, April, 1945." His talk was illustrated with pictures in color, and he described his visit to Germany to report scientific development there which could be used in the war against Japan. On his mission he visited Munich and southwest Germany, and later, Paris and London.

"Atomic Energy" Subject at Ithaca Section

R. Clifton Gibbs, professor of physics at Cornell University, was the speaker at the Nov. 16 meeting at Willard Straight Hall, Ithaca, N. Y. Professor Gibbs discussed nuclear physics against the background of his own experiences. He illustrated the atomic structure with models, one of which "captured" and "discharged" electrons, protons, neutrons, and "split" when struck by a "slow neutron."

Dr. Gilbreth, Speaker at Louisville Section

On Nov. 7 Dr. Lillian Gilbreth, member A.S.M.E., professor of management at Purdue University, was the guest speaker. Approximately 200 people heard this noted lecturer discuss various problems and explain how we can help management solve them. The audience was very receptive and stayed long after the meeting to discuss the talk and personally thank Dr. Gilbreth for her message.

GROUP FROM MILWAUKEE ENJOYING THEMSELVES AT THE 1945 A.S.M.E. ANNUAL DINNER

MEMBERS OF MILWAUKEE SECTION VISIT SUBMARINE U.S.S. "MERO"

(On Saturday, October 13, members of the Milwaukee Section of the A.S.M.E. were the guests of the U. S. Navy for a visit through the submarine U.S.S. *Mero*, last of 28 submarines built at Manitowoc, Wisconsin. Members were also permitted to bring their families. It was a gala event, especially to watch the landlubbers and their wives getting in and out through the narrow escape hatches. Of interest to the ladies was the tiny galley which provides cooking facilities for eighty-one men, and the washing machine located adjacent to the shower room. The spotless condition of the entire ship was also prominent.. From an engineering standpoint, the gleaming controls, carefully located equipment, instrument and control rooms, living quarters, and in particular, the exacting details provided to facilitate the crucial purpose of the submarine were a startling revelation to those not acquainted with Naval design.)

Lecture and Inspection Tour at Minnesota Section

A dinner meeting was held on Oct. 9 at the Coffman Memorial Union, University of Minnesota, Minneapolis, Minn., following which the members and guests adjourned to the physics auditorium where an illustrated lecture entitled "Atomic Energy" was given by Prof. J. W. Buchta of the University. The audience then made an inspection tour of the physics laboratory, and especially the atom smasher. Forty-seven members and guests were present.

"Aerial Tramways" Subject at New Haven Section

On Nov. 14 at Ceriani's Cafe Mellone, New Haven, Conn., Gordon H. Bannerman, chief bridge and tramway engineer, American Steel and Wire Company, addressed the members on "Aerial Tramways." He mentioned the various types of tramway and cableway construction and described several important installations made by his company. He illustrated his talk with slides and movies.

Ontario Section Inspects the "Mulberry"

The Section members were guests of The Engineering Institute of Canada on Nov. 8, when they attended a special evening showing of "Mulberry," the U. K. War Office model of the prefabricated harbor used in the Allied liberation of Europe, on view at Robert Simpson Company, Ltd.'s, offices at Toronto, Can. The model, now on its tour of twelve principal cities in Canada, is the identical large-scale replica used by the Allied Chiefs of Staff in planning the real invasion. The trip through the Mulberry Exhibition provided an unforgettable picture of one of the mightiest constructive operations in the world's experience, and 350 members were privileged to see this exhibit.

A.S.M.E. NEWS

Sections

"Fido" Fog-Dispersing System Inspection by San Francisco Representative

ON Oct. 3 the Public Relations Office of the U. S. Naval Air Station, Alameda, Calif., arranged a trip to the Arcata, Calif., Naval Auxiliary Air Station, for some 15 press and radio men, to attend the first public demonstration of the "Fido" fog-dispersing system. Through the courtesy of the C. C. Moore Company, West Coast agents of Babcock and Wilcox Company, a representative of the Section was invited to represent the A.S.M.E., and Dr. A. G. Catanee, chairman of the Section's Professional Divisions Committee, was selected.

Dr. Catanee, in his report of this trip, states that Arcata, Calif., situated on bluffs overlooking the Pacific Ocean 300 miles north of San Francisco, has the highest incidence of fog of any Naval Air Station in the continental United States (not including Alaska) and was therefore chosen as the site of the Navy's "Landing Aid Experiment Station." The experimental work on fog-dispersing systems is done under general direction of Commander J. B. Lunger, Bureau of Aeronautics, Washington, D. C., and carried out by Lieut. R. L. Champion and his assistants at Arcata.

As an experiment station, Arcata has not one but many fog-dispersing systems in operation or in the process of installation. These are divided into the thermal and mechanical types. A team of engineers from the University of California engineering department, under Dean M. R. O'Brien, has just begun to study the mechanism of fog dispersion by burners, and it may thus be hoped that some insight into the efficiency and ultimate possibilities of man's first assault on a weather phenomenon will be gained.

Dr. Catanee sums up his experience in these words: "This observer was more struck by the inadequacy of our present energy sources versus one of the mildest and least stable phenomena of nature in the confines of only one fiftieth of one cubic mile of atmosphere."

Oak Ridge Atomic Bomb Plant Described at Boston Section

At the Nov. 20 meeting at Harvard University, Cambridge, Mass., A. C. Klein and W. Wisner presented a complete word picture of the part played by the engineers in the erection and operation of the Oak Ridge Atomic Bomb plant. Explanation of the difficulties arising from the conversion from the scientists' laboratory models to practical working plants formed the major part of the talk. Eight hundred were in the audience.

"Pressure Combustion" and "Atomic Bomb" Subjects at Central Illinois Section

On Oct. 11 at the University Club, Peoria, Ill., Irwin D. Groak gave a talk on "Pressure Combustion." Mr. Groak discussed the testing equipment for turbosuperchargers, the gas turbine and its application, the materials used in construction, and operating characteristics. In the question period which followed, the future of turbine power and design problems was also discussed.

Lieut. Col. T. A. Derry was the speaker at the Oct. 25 meeting at Bradley Hall, Peoria, Ill. His subject, "The Development and Operation of the Atomic Bomb," drew a large audience numbering 450. To illustrate his talk Lieut. Derry showed a film depicting the testing of the bomb, as well as the final results.

On Nov. 8 a meeting was held at Bradley Hall, Peoria, Ill., when Dr. Lillian M. Gilbreth, member A.S.M.E., professor of management at Purdue University, spoke on "Our Part in Solving Today's Management Problems." In her talk Dr. Gilbreth discussed women's place in industry, as well as the importance of management's relations with labor, and the necessity of a peaceful solution at an early date of the problems now confronting both. An audience of 150 enjoyed Dr. Gilbreth's lecture.

Otto de Lorenzi Is Heard at Chicago Section

A meeting was held on Nov. 6 in the Little Theatre, Civic Opera Building, Chicago, Ill., when Otto de Lorenzi, member A.S.M.E., of the Combustion Engineering Company, New York, N. Y., gave a talk on "Studies of Fuel Beds and Furnace Conditions." Mr. de Lorenzi illustrated his talk with slides and films in kodachrome. As the speaker explained what actually happens in the feeding and burning of coal in furnaces, the unusual films vividly augmented his description.

On Nov. 19 at the Museum of Science and Industry, Chicago, Ill., Dr. J. T. Rettaliata, junior member A.S.M.E., presented a historical review of the gas turbine from the 17th century to the present, the theory of operation, construction, and application, illustrated with slides. A general discussion followed the talk, in which application of the gas turbine in the Houdry process, locomotive, powerplant, and airplane, was discussed from all engineering aspects. The audience totaled 114.

Rupen Eksergian Speaks at Cleveland Section

At the Nov. 8 meeting held in the Cleveland Engineering Society Building, Cleveland, Ohio, the speaker was Rupen Eksergian, fellow A.S.M.E., Worcester Reed Warner Medalist 1939, with Edward G. Budd Manufacturing Company, Philadelphia, Pa. Mr. Eksergian, whose subject was "Locomotive Power Characteristics," gave an illustrated talk on the different types of motive power, and the points of advantage of each of the various locomotives now in use. One hundred and twenty-five members and guests were present.

Speaker at Colorado Section Discusses Private and Commercial Air Travel

"Aeronautical Engineering" was the subject discussed at the meeting on Nov. 9 at the Oxford Hotel, Denver, Colo. The speaker, Al Shelly, of the Continental Air Lines, first outlined the part which private planes, including the helicopter, will play in future air travel. He discussed the new design features of commercial air transports and made interesting comparisons of the present DC-3 and the future DC-8. Thirty-five members and guests were present.

Col. C. E. Davies Talks on A.S.M.E. at Detroit Section

On Nov. 6 at the Rackham Building, Detroit, Mich., Col. C. E. Davies, secretary, A.S.M.E., gave an informative and interesting talk on Society organization activities and financial structure. A discussion from the floor brought out many interesting points, and the members expressed satisfaction at having been given this insight into Society activities. One hundred members and guests were present.

Sound Film Featured at East Tennessee Section

A meeting was held on Nov. 2 at the Kingsport Utility Building, Kingsport, Tenn., when a sound movie entitled "Building Boilers for Liberty and Victory Ships" was shown, with comments by A. W. Harris, member A.S.M.E. Forty-six members and guests attended.

Report on Military Science Mission at Erie Section

The Oct. 29 meeting was held at the Press Club, Erie, Pa., when H. W. Gouldthorpe of

PRESIDENT BAILEY BEING CONGRATULATED BY A GROUP OF PITTSBURGH WOMEN ON HIS TALK TO THE PITTSBURGH SECTION, ENTITLED "A MESSAGE TO THE LADIES"

President Alex D. Bailey Guest at Pittsburgh Section

On Nov. 12 a dinner meeting was held for members and their wives, at Pittsburgh, Pa., preceded by a reception for Alex D. Bailey, fellow A.S.M.E., and at the time of the meeting, president A.S.M.E. Over 300 were in attendance.

Former vice-president of the A.S.M.E., T. E. Purcell, acted as toastmaster and introduced President Bailey, outlining the latter's many outstanding contributions to the field of mechanical engineering. President Bailey, whose talk was entitled "A Message to the Ladies," gave a brief outline of the history and organization of the A.S.M.E. and told of the many activities of the Society in leading the engineering profession in civic affairs. The women present heartily applauded two points in President Bailey's address: (1) Encourage your husbands to be active in A.S.M.E. affairs, and (2) A.S.M.E. members should take their wives to conventions.

Two Speakers at Meeting of Plainfield Section

On Nov. 21 at the Park Hotel, Plainfield, N. J., "Electronics—Present and Future Applications" was the subject discussed by Earl K. Murphy of the Westinghouse Electric Corporation, and "Postwar Quality Requirements of Management," the subject discussed by Eugene H. McNiece of Johnson and Johnson. A total of 85 attended the meeting.

"Job Evaluation" Subject at Providence Section

On Nov. 6 in the Providence Engineering Building, Providence, R. I., Dean Asa S. Knowles, member executive committee, A.S.M.E., of the Rhode Island State College, spoke on "What Management and Labor Can Expect of Job Evaluation." So interesting did Dean Knowles make his talk that the question period which lasted an hour had to be closed as there was no letup in the questioning.

Raleigh Section Sponsors Forestry Program

On Oct. 22 at the North Carolina State College, Raleigh, N. C., the Section sponsored a forestry program, consisting of an illustrated lecture entitled "Forestry Fire Prevention and Control," by Dr. J. V. Hofman, director of the division of forestry at N. C. State College. Pictures of forests and their devastation by fire, and fire-fighting equipment and its use, were shown. Dr. Hofman's talk aroused so much interest that a 40-minute question period followed. This program was most worth while, and Prof. E. G. Hoefer, member A.S.M.E., professor of mechanical engineering, N. C. State College, was complimented for his arrangement of such a fine program.

Rochester Section Hears Garth Stroup

Garth Stroup, Dodge Manufacturing Corporation, Mishawaka, Ind., was the speaker at the Nov. 8 meeting in the Hotel Sheraton, Rochester, N. Y. Mr. Stroup's subject was "The Practical Side of Plain Sleeve and Antifriction Bearing Mounting." He gave a historical description of the sleeve bearing type from its simplest form to the modern liquid-cooled type to meet special operating conditions, and the audience of 104 agreed that Mr. Stroup's talk was admirably presented.

This was a joint meeting with the Rochester Engineering Society.

Rock River Valley Section Meets With University of Wisconsin Branch

Joining with the University of Wisconsin Branch, an afternoon and evening meeting was held on Nov. 14 in Madison, Wis. The afternoon session, held in the mechanical-engineering building, consisted of a talk by Phil Myers, instructor in mechanical engineering, University of Wisconsin, entitled "Flame-Temperature Measurement in an Internal-Combustion Engine." The subject discussed was based on research conducted at the University, which included an outline of the theory and technique employed, with a demonstration of the equipment used. The dinner meeting was held in the Memorial Union Building of the University, when L. J. Markwardt, assistant director, United States Forest Products Laboratory, spoke on "Wood as an Engineering Material." He described the growth, structure, chemical nature, and physical properties of wood, as well as factors in design. He explained the developments in wood, plastics, and modified wood, including papreg and compreg, and their uses. Slides accompanied the talk, showing wood under the microscope, how wood grows, and wood structures being erected. An array of samples was displayed, showing various woods and modified woods. A discussion period followed. There was a total attendance of 70.

PRESIDENT BAILEY IS WELCOMED TO PITTSBURGH FOR PRESIDENT'S NIGHT, NOVEMBER 12, 1945

(*Left to right:* T. Fort, vice-chairman, Pittsburgh Section; T. E. Purcell, former A.S.M.E. vice-president, and toastmaster for evening; President Bailey; H. F. Hebley, chairman, Pittsburgh Section.)

Discussion of Management Problems at St. Joseph Valley Section

On Nov. 8 at Notre Dame University, South Bend, Ind., Dr. Lillian Gilbreth, member A.S.M.E., professor of management, Purdue University, and president of Gilbreth, Inc., Montclair, N. J., was the guest speaker. Her talk, "Our Part in Solving Today's Management Problems," was enjoyed by an audience of 200.

Tri-Cities Section Features Joint Meeting

"The Use of Insulating Materials in Solving Heat-Control Problems" was discussed by Walter L. Steffens, Phillips Corey Manufacturing Company, at the Oct. 15 meeting in the Hotel Blackhawk, Davenport, Iowa. This was a joint meeting with the Moline Association of Power Engineers and National Association of Power Engineers and the Clinton Engineer's Club. Mr. Steffens sketched the development of the application of insulation in buildings, and insulation as applied to industrial piping. Economic and technical factors in these two fields were discussed and analyzed.

On Nov. 19 in the Power Company's auditorium, Moline, Ill., a paper, "Basic Principles of Supervision for Safe and Efficient Production," by H. W. Heinrich, was presented by D. J. Balfour of the Travelers' Insurance Company. An interesting discussion followed the reading of the paper, which was published in the November, 1945, issue of MECHANICAL ENGINEERING, page 701.

Dr. Lillian M. Gilbreth Speaks at West Virginia Section

Dr. Lillian M. Gilbreth, member A.S.M.E., professor of management at Purdue University, and president of Gilbreth, Inc., Montclair, N. J., was the speaker at the meeting on Nov. 5 at the Daniel Boone Hotel, Charlestown, W. Va. Her talk on "The Engineer's Part in Solving Postwar Management Problems," was so interesting, and the speaker's enthusiasm for her subject so marked, that every engineer in the audience of 200 felt proud of his profession. It was a privilege for the members to be associated with as vital a person as Mrs. Gilbreth.

"Air Transportation" Talk at Worcester Section

On Nov. 16 a meeting was held in the Janet Earle room, Alden Memorial, Worcester Polytechnic Institute, Worcester, Mass., when Col. Chester Hammond of the Pan American World Airways, gave a talk, illustrated with motion pictures, on "International Air Transportation." Mr. Hammond predicted that in about 20 months planes carrying 200 people, 6 motors, 3 decks, pressurized cabins, flying from 20,000 to 40,000 ft, would cross the Atlantic in 9 hours, at a round-trip cost of $180.

Student Branches

Dr. Laurence A. Hawkins Addresses 1945 Annual Student Luncheon

Takes as His Topic "The Problems We Face"

ON Wednesday, Nov. 28, in Penn Top on the roof of the Hotel Pennsylvania, New York, N. Y., during the Annual Meeting of the A.S.M.E., the National Research Committee joined with the Student Branches in a general luncheon. Over 116 students were present, many in uniform, a far greater number than last year when we were at war.

President Alex D. Bailey opened the meeting, after luncheon had been served, and introduced the guests at the speakers' table. These included R. P. Reese, chairman-elect, Standing Committee on Relations With Colleges; Dean George Leonard Sullivan, chairman, Standing Committee on Relations With Colleges; D. Robert Yarnall, president-elect, A.S.M.E.; Major General B. W. Chidlaw, deputy commander, engineering, Wright Field, Dayton, Ohio; Dr. Laurence A. Hawkins, speaker of the day; Colonel C. E. Davies, secretary A.S.M.E., Colonel Wm. H. McLean, R.E.S. and Development Branch, Office of Quartermaster General, Washington, D. C.; Rear-Admiral H. S. Bowen, honorary member (elect) A.S.M.E., director of research and inventions, U. S. Navy, Washington, D. C.; Major General G. M. Barnes, member A.S.M.E., director of research and development, Ordnance Department, U. S. Army, Washington, D. C., and J. W. Erickson and Jack Drandell, winners of awards.

Mr. Bailey then asked President-Elect Yarnall to introduce these two young men. Mr. Yarnall said that he was pleased to see so many splendid young men sitting with the regular members of the Society, for it was good for the members to know them and for them to meet the members. He remarked that every one is born a citizen but each one chooses one's profession or avocation. He quoted a statement made by one of the old Christian Fathers of centuries ago, "The soul of a man is stamped by the objects of his choice." Mr. Yarnall continued, "You have made a great choice when you have decided engineering as your profession and have become a student member in this great society of 20,000 members. Another choice will confront you before long; follow that choice by becoming a junior member of the society. Another choice will then be offered, that of becoming a full member of the Society. There are potential presidents, vice-presidents, managers, and committee-chairmen, in this group of 116. All of these jobs are open to you young men, and it is a great privilege indeed to throw open this opportunity to you. You have chosen engineering as your profession. Live with it and make it greater than it is today."

Presentation of Awards

Mr. Yarnall asked Dean Sullivan to present the awards. The Charles T. Main award, established in 1919, awarded for the best paper within the general subject of the influence of the profession upon public life, was presented to Jack Drandell for his paper "Engineering in the New South." Mr. Drandell attended the School of Engineering of Southern Methodist University, Dallas, Texas. During his college career he became a member of the A.S.M.E. Student Branch. He graduated with honor in June, 1945, with the degree of B.Sc. in M.E., and is at present employed by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. He is now a junior member A.S.M.E.

The undergraduate student award, established in 1914, and presented for the best paper or thesis submitted by student members, was awarded to John Waldemar Erickson, for his paper "Increasing the Efficiency of Gas Turbine Cycles." Mr. Erickson received his training at U.S.N.E. Midshipmen's School, New York, N. Y., and is now on active duty with the Navy as an ensign. Previous to this, a degree in mechanical engineering was granted to him by the Illinois Institute of Technology, where he worked as a co-operative student until he was called to active status in the Naval Reserve as a V-12 student. He is a junior member A.S.M.E.

Dr. Hawkins—the Speaker

Mr. Bailey introduced the speaker of the afternoon, Dr. Laurence A. Hawkins, formerly executive director, research laboratory, General Electric Company, Schenectady, N. Y. Dr. Hawkins chose as his subject "The Problems We Face." He said that no engineering society had ever considered a more important subject than that to which attention was to be given during his talk, a subject, the consequences of which may affect all phases of our national life. "There will be little consolation or lasting peace in our own domestic relations," he remarked, "if our policy is to be that of distilling fear and distrust in other nations." Dr. Hawkins then spoke of the tremendous power of organized research, and his anxiety to see that it is utilized in the constructive processes of peace, as it was applied in the destructive processes of war. There had been very little research in American universities up to 1914, and there were few industrial research laboratories. After the United States entered the war, research work began to grow, research laboratories multiplied with the result that all these resources were effectively

organized at the beginning of World War II. He spoke of the miracle of radar, and said that science had at last broken down the bars, until today the public thoroughly endorses the wish expressed a year or so ago by the late President Roosevelt, that this power of organized science may be carried over to peace for the national good.

Dr. Hawkins expressed his own opinion very firmly that research for public health and basic science should be conducted by universities and nonprofit research institutions, and he further said that we cannot afford *not* to maintain our military research. Dr. Hawkins closed his talk with a few remarks on the international aspects of atomic engineering. He said all scientists are agreed that all the fundamentals on which the atomic bomb is based are known to all the world—the engineering "know how." The full text of Dr. Hawkins' speech will be found on pages 11–13 of this issue.

Columbia University Branch

At the meeting on Nov. 16, which was the first of the winter term, the new officers presided: Alan Cook, president; Henry Coleman, vice-president; Frederick Holte, secretary, and John O'Keeffe, treasurer. The program presented was an illustrated talk on the engineering problems encountered in foundry practice, given by Mr. Talbott, general manager of the Cooper Alloy Foundry of North Jersey. Mr. Talbott covered all phases of foundry work, emphasizing the need for trained men in this field.

Georgia Tech Branch

In conjunction with the Atlanta Section of the A.S.M.E. a very successful dinner meeting was held on Saturday evening, Dec. 8. About 45 student members and more than 60 members of the Section were present and partook of T-bone steaks, French fried potatoes, and cherry cobblers a-la-mode. Earle Mauldin, member A.S.M.E. and southern editor for the McGraw-Hill Publishing Company, did an able job as master-of-ceremonies in introducing the speakers of the evening, Ray N. Benjamin, Georgia Power Company; Eugene Sterne, The Scripto Co.; O. O. Rae, Westinghouse Electric Co.; Robert Griffith, General Electric Co.; R. S. Lynch, Atlantic Steel Co.; and Prof. R. L. Allen, secretary of the Atlanta Section of the A.S.M.E. The speakers from industry outlined the many opportunities that are open today for graduate mechanical engineers in their companies. In conclusion, the officers of the Branch, R. H. Kerce, president, Paul Tombaugh, vice-president, and Charles Schneider, secretary-treasurer, thanked the speakers for coming and the excellent advice which they gave.

Iowa State College Branch

The first meeting of the winter semester, held on Nov. 12, at 209 Engineering Hall, was called to order by Steve Shea, president. The type of booth to be erected by the Branch at the Iowa State Engineers' Carnival was discussed and a carnival committee named, consisting of Tom Acker, Roger Bowden, Ralph Marrs, Steve Shea, and Messrs. Saxon and Williamson.

ATLANTA SECTION AND GEORGIA TECH STUDENT BRANCH OF THE A.S.M.E. HOLD JOINT DINNER MEETING TO DISCUSS JOB OPPORTUNITIES FOR GRADUATE MECHANICAL ENGINEERS

(*Left to right, sitting* Robert Griffith, O. O. Roe, R. S. Lynch, J. A. Dodd, Section chairman, T. E. Smith, Section Student Committee chairman, and, *standing*, Earle Mauldin, master of ceremonies, E. J. Stern, George B. Hills, new senior vice-president, W. B. Klinke, president of Student Council and new president of senior class, being congratulated by R. H. Kerce, chairman of Student Branch, Paul Tombaugh, student vice-chairman, R. L. Allen, Section secretary, and Ray Benjamin.)

New officers were elected as follows: Roger Bowden, president; Donald Meier, vice-president; Donald Roush, secretary; and Ralph Marrs, treasurer.

University of Maryland Branch

At the meeting of Oct. 24 in the Engineering Building, there was a marked increase in membership and attendance. Also represented were the student chapters of A.S.C.E., A.I.E.E., and A.I.Ch.E.

Paul Piper, chief of the weights and balancing division, Glenn L. Martin Aircraft Company, was the speaker. He discussed the important problems connected with the reduction and redistribution of weight in aircraft design.

Montana State College Branch

The first meeting of the new semester was held on Oct. 23 at Roberts Hall, under the supervision of Prof. R. E. Gibbs, member A.S.M.E., head of the department of mechanical engineering. Professor Gibbs described in detail to prospective members the value of the A.S.M.E., and applications were distributed. Officers for the coming year are George Seel, chairman; Robert Nelson, vice-chairman; Mark Sullivan, secretary, and Peter Roberts, treasurer.

University of Nevada Branch

The first meeting since the war was held on Nov. 13 in the engineering building. Prof. James R. Van Dyke, member A.S.M.E., who presided, called the meeting by using an old prewar sign.

The purpose of this meeting was to tell the new members about the A.S.M.E., its rules, and other details of interest. Election of officers and a membership committee was held.

University of New Mexico Branch

The program of the Oct. 8 meeting, held in the mechanical engineering building, room 3, was a motion picture, "The Powerhouse of Aviation," shown through the courtesy of the Curtiss-Wright Corporation. The following officers were elected: Paul Dugan, chairman; Eugene Blake, vice-chairman; Louis Previati, secretary-treasurer.

New York University Evening Branch

The first meeting of the new school year was held on Oct. 31 in the main building, Washington Square, New York, N. Y. S. J. Rudy, chairman of last season, presided.

Election of officers took place, with the following results: Edward Edwin, chairman; Charlotte Northecote, vice-chairman; Robert C. Wood, secretary, and Thomas Williams, treasurer.

Dean R. L. Sackett, fellow A.S.M.E., assistant to the secretary of A.S.M.E., addressed the members on "Engineering Side Lights." Dean Sackett stressed the importance and need of technical societies in this modern world.

Northeastern University Branch

A motion picture, "Unfinished Rainbows," was the program at the Nov. 1 meeting in Richards Hall, room 200 R. The film showed in historical sequence the story of aluminum.

University of Rochester Branch

On Nov. 13 the first meeting of the current semester was held in the engineering building. Charles Nixon, chairman of the social committee, presented plans for a semiformal dance to be held on Dec. 8. A prize of an engineering handbook is to be presented to the member giving the best talk of the semester. Following the business meeting, two films were shown entitled, "This Is China," and "The Fleet That Came to Stay."

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to members and is operated on a co-operative, nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit, personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available to members of the co-operating societies at a subscription of $3 per quarter or $10 per annum, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	212 West Wacker Drive	109 Farnsworth Ave.	57 Post Street

MEN AVAILABLE[1]

MECHANICAL ENGINEER, 30 years' experience in design and construction, 12 years in heavy machinery and general plant work, 18 years in chemical industry, 14 of which were in executive capacity. Available for executive or administrative engineering position. Philadelphia or Southern New Jersey. Me-975.

MECHANICAL ENGINEER, M.S. degree, P.E. license, 28, five years' diversified experience as project engineer in research, design, and development work, on mechanical and hydraulic mechanisms and machinery. Responsible for design, checking, and testing. Desires responsible position in East. Me-976.

FACTORY MANAGER, superintendent or production manager. Graduate mechanical engineer with 25 years' experience in manufacture and assembly of interchangeable parts. Prefers New Jersey or New York but will go elsewhere. Me-977.

ASSISTANT TO MANAGEMENT, M.E., 33, eleven years' practical experience in steel fabrication, responsible for: Organization and operation of production departments; process development; metallurgical, welding, and industrial engineering. East preferred. Me-978.

MECHANICAL ENGINEER, graduate, age 29. Nine years' varied experience on precision instruments. Four years as manufacturing engineering supervisor, two years assistant production manager, two years design, one year materials laboratory. Me-979.

ENGINEER, E.E., age 31, two years' experience in manufacture of small motors, die and tool design; six years in radio, radar, and electrical aircraft installations, also jet propulsion. Desires position requiring initiative and original ideas. Me-980.

GRADUATE MECHANICAL ENGINEER, 30, eight years' industrial experience in small-parts manufacture—time study, tools and gages, quality control, purchasing, supervision; desires responsible position in East. Will travel. Me-981.

GRADUATE MECHANICAL ENGINEER, 32, married. Three years' engineering-design experience in aircraft gas-turbine and jet-propulsion developmental test equipment and facilities. Familiar with large variety of mechanical equipment. Me-982.

SALES ENGINEER, graduate M.E., nine years' experience machine-tool and allied fields, three years U. S. Navy inspection director Midwest district, desires sales-engineering position, headquarters, N. Y. metropolitan area. Me-983.

MECHANICAL AND AERONAUTICAL ENGINEER, 27. Broad experience in stress and vibration analysis on internal-combustion engines, marine installations, heavy forging equipment. Project organization and customer liaison work. Fluently spoken and written Russian, some French and Chinese. Me-984.

GRADUATE MECHANICAL ENGINEER, married, 30. Four years industrial relations—fire, plant protection, and safety, public relations and advertising, four years safety engineering with insurance company. Desires position in West or Southwest. Me-985.

MECHANICAL ENGINEER, graduate, 25, desires permanent position with small manufacturing or processing concern. Three years' intensive experience operating high-pressure gas Navy plant; additional personnel and administrative experience. Any location. Available January 1, 1946. Me-986.

GRADUATE MECHANICAL ENGINEER, age 29. Over two years' industrial experience in production engineering. Year and a half production experience with U. S. Navy Bureau of Aeronautics mostly connected with conversion problems. Other experience as aircraft maintenance officer. Interested in production management and labor problems; desires location in that field. Me-987.

MECHANICAL ENGINEER, '42, Lieutenant U.S.N.R. Two years' supervisory experience in ship repairs and alterations. Now completing 18-month postgraduate engineering course at P.G. School, U. S. Naval Academy. Position in production or administration preferred. Available January. Me-988.

GRADUATE MECHANICAL ENGINEER, 28, married, five years' experience in specifications, technical writing, process engineering, design and contact work. Good knowledge metallurgy. Desires technical sales or development work in metropolitan area. Me-989.

MAINTENANCE ENGINEER, 32, mechanical graduate, nine years' experience supervising engineers, engineering design, construction, crafts and union labor on chemical, gas, power, and shop work. Prefer Ohio, Indiana, Michigan. Me-990.

MECHANICAL ENGINEER, graduate, 29. Over six years' experience developing, designing, and checking special automatic machinery. One year editing experience. Seeks opportunity leading to administrative position. Prefer medium-sized, east-coast organization. Me-991.

PURCHASING AGENT, 46, M.I.T. graduate mechanical engineering. Twenty years' experience in three large corporations. Familiar with both single- and multiple-plant purchasing procedure. Available immediately, prefer Continental United States. Me-992.

MECHANICAL - METALLURGICAL - PRODUCTION ENGINEER, 33, married, Stevens, 6½ years' broad tool-steel and tungsten-carbide application in extensive cold- and hot-metal fabrication; 2½ years responsible ordnance production administration. Desires engineering or administrative position with future. Me-993.

EXECUTIVE ENGINEER, graduate mechanical. 47, twenty-five years' plant supervision, chief engineer and plant engineer. Knows mass production, organization, methods, costs, job analysis; design, dies, tools, jigs, and fixtures, and machinery. Has family. Wants management, top executive assistant or chief engineer. Me-994.

MECHANICAL ENGINEER, Columbia graduate, twenty-five years in power-station operation, statistics, personnel, writing, mainly in public utilities, lately on Navy contract, wants permanent work, preferably in New York City. Me-995.

POSITIONS AVAILABLE

INDUSTRIAL ENGINEER, not over 45, with time-study and methods-analysis experience, to make material-handling surveys. Considerable traveling, mostly in the East. Salary open. Headquarters, New York, N. Y. W-6261.

DUST AND VENTILATON ENGINEER, 35–40, mechanical graduate, with at least five years' experience, to design, lay out, install, and operate successful dust-exhauster systems in asbestos mills, as well as dust suppression and elimination measures to be undertaken. Wide experience in this type of work in heavily dust-concentrated industries such as cements, etc., desired. $3000–$4000 year. Canada. W-6268.

COMBUSTION ENGINEER to head smoke-abatement commission for industrial city in South. $5000 year. W-6270.

PLANT MAINTENANCE ENGINEER experienced

[1] All men listed hold some form of A.S.M.E. membership.

in planning machine and assembly-line layouts, supervising millwrights, plumbing, electrical, and other installations; also experienced in planning and supervising erection and maintenance of building, heating, and ventilating equipment. Ohio. Interviews, New York, N. Y. W-6277.

AIR-CONDITIONING ENGINEER, graduate mechanical, 27–35, to aid in design of self-contained room air-conditioning units up to 1-hp capacity; includes testing of motors, fans, evaporators, condensers, filters, insulation, compressors, and balancing such a system. Will be in charge of testing laboratory. Should have background in design work with some manufacturing and application experience. $3600–$4200 year. Ohio. W-6278D.

AUTOMOTIVE ENGINEER to supervise purchasing and maintenance in connection with operation of fleet of 550 motor vehicles. Primary responsibility will be purchase of motor vehicles and establishment and review of effectiveness of methods of maintenance. Must be familiar with types and methods of body construction as man will be responsible for working with outside companies in selection of chassis and engines and of body design. Salary open. Pennsylvania. W-6288.

MAINTENANCE ENGINEER to report to chief engineer and be responsible for modifications to and maintenance of all processing equipment. Work will deal with equipment located in milk and ice-cream processing plants; therefore should be experienced in installation and maintenance of milk or food-plant processing equipment and heat-generating units. Should be qualified to figure milk-plant production loads in order to specify equipment. Salary open. Pennsylvania. W-6289.

ASSISTANT OR ASSOCIATE PROFESSOR for department of mechanical engineering. Should be mechanical-engineering graduate with master's degree and some industrial experience. Should be qualified to teach mechanisms, machine design, and power plants. Salary on nine-month basis, $3000–$3300 year. Middle West. W-6296C.

CHIEF ENGINEER to organize and direct process-engineering division for an established, nationally known, heavy-equipment manufacturer desirous of expanding into the design of process equipment for the petroleum, chemical, and power-plant fields. Should have experience in design of fabricated high-pressure shell and tubular products, columns, etc., and should be thoroughly acquainted with modern concepts of heat transmission. Knowledge of water-treating and of absorption principles are desirable. Position offers unusual opportunity for growth with very progressive organization. $6000–$8500 a year. Pennsylvania. W-6297.

ENGINEER to study methods, all controls with object of assuming substantial management responsibility as soon as qualified, for company manufacturing enameled iron plumbing fixtures. Iron foundry experience essential. Energy, ability to get along with others, and common sense required. Apply by letter stating age, education, experience, salary desired. Include recent snapshot. Ohio. W-6301-D.

INDUSTRIAL ENGINEER, not over 45, with experience in woodworking industry, for methods and wage-incentive work. Considerable traveling involved although present position might mean one year in New England. $6000–$7000 year. Headquarters, Middle West. W-6330.

SUPERINTENDENT OF POWER, 28–35 mechanical or electrical graduate. Must have experience in power-plant maintenance and operation, and design and construction of power-distribution systems. Write stating age, experience, marital status, education, present and expected salary. Send photograph. India. W-6359.

Candidates for Membership and Transfer in the A.S.M.E.

THE application of each of the candidates listed below is to be voted on after January 25, 1946, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

AVAKIAN, ARRA S., York, Pa.
BAKER, JOHN, Chicago, Ill.
BARAN, WOLODEMER K., New York, N. Y.
BARKER, E. C., Chicago, Ill.
BELL, GRAHAM H., Montclair, N. J.
BESSERER, C. W., JR., Silver Spring, Md.
BLACK, JAMES S., Pittsburgh, Pa.
BOEHM, FREDERICK, Philadelphia, Pa.
BROOKS, D. A., Freeport, Texas
BRYANT, AUSTIN, Berkeley, Calif.
CAIRNS, JAMES J., Belmont, Mass.
CANFIELD, BAILEY L., Elkhart, Ind. (Rt & T)
COLGAN, WILLIAM J., Philadelphia, Pa.
COLONAS, JOHN MARK, San Francisco, Calif.
CROSSLAND, WINFORD D., Oak Ridge, Tenn.
DEANE, CHARLES W., Summit, N. J.
DE ZAFRA, CARLOS, New York, N. Y. (Rt)
DONNALLY, FITZHUGH, JR., Mineola, N. Y.
EDICK, RICHARD S., New York, N. Y.
ELLIOTT, MARTIN A., Pittsburgh, Pa.
EMERY, WILLIAM M., Summit, N. J.
ENGLANDER, ROBERT PAUL, Norwalk, Conn.
FALK, MARTIN C., Pittsburgh, Pa.
FERRARO, JOSEPH V., New York, N. Y.
FLYNN, CHARLES A., Jr., Somerville, N. J.
FONTAINE, W. E., Lafayette, Ind.
GARDAY, LOUIS J., Glenview, Ill.
GARDNER, R. M., Knoxville, Tenn.
GOSS, JAMES H., Marblehead, Mass.
GREER, EDWARD M., West Hempstead, N. Y.
HAGEL, HERBERT N., Forest Hills, N. Y.
HANCE, L. W., Philadelphia, Pa.
HENRY, N. R., Atlanta, Ga.
HERRICK, THOMAS EDWARD, JR., Philadelphia, Pa.
HEWETT, WALTER, Loughborough, Leic., England
HISCOX, ORNE HARTT, Garden City, N. Y.
HOMAN, ROBERT M., Reading, Pa.
ISENBURGER, HERBERT R., Long Island City, N. Y.
JENKINS, D. S., Preston, Melbourne, Australia
JOHNSON, ERNEST E., Scotia, N. Y.
JOHNSON, HARRY CONRAD, Howard Beach, N. Y.
JOHNSON, R. O., Guelph, Ontario, Can.
JOHNSON, STANLEY T., Chicago, Ill.
JOHNSON, WALTON P., Tulsa, Okla.
JONES, FORREST E., Neodesha, Kansas (Rt)
KEARNS, JOHN E., Montreal, Quebec, Can.
KES, ANTHONY, JR., Rutherford, N. J.
KLOCK, FRANKLIN G., JR., Hollywood, Calif.
KOCH, GUNNAR, Skene, Sweden
KOENIGSBERGER, F., Manchester, England
LAPIDUS, SOLOMON, Brooklyn, N. Y.
LASLEY, ROBERT A., Chicago, Ill.
LEA, ROBERT B., Lake Success, N. Y. (Rt)
LENGQUIST, ROBERT, Kansas City, Mo.
LEONARD, FREDERIC B., Chevy Chase, Md.
LINARES, CARLOS T., Schenectady, N. Y.
LINDGREN, ROY W., Brookline, Mass.
LIVINGSTON, BERYL E., Jeannette, Pa.
LONG, E. CURTIS, Los Angeles, Calif.
MARSH, ROBERT H., Birmingham, Mich.
MCCANN, GILBERT D., JR., East Pittsburgh, Pa.
MCFARLAND, JOHN J., JR., Chicago, Ill.
MCKEE, ROBERT JAMES, Corry, Pa.
MCKINZIE, DANIEL J., Yonkers, N. Y.
MILLER, E. P., Zion, Ill.
MILLER, ROBERT I., Philadelphia, Pa.
NELLIGAN, THOMAS P., Winnetka, Ill.
NEWMAN, MARCEL K., Oradell, N. J. (Rt & T)
NOBLE, EUGENE E., Tuckahoe, N. Y.
PACKARD, NORMAN A., Cranford, N. J. (Re)
PETERSEN, HAROLD J., Knoxville, Tenn.
PRINCI, MARK A., West Lynn, Mass.
PRUPIS, ROBERT I., Irvington, N. J.
ST. CLAIR, WILLIAM THADDEUS, (MAJOR), Oak Ridge, Tenn.
SALZER, RUDOLPH A., Trenton, N. J.
SANDS, WILLIAM ROBERT, Wilmington, Del.
SAR VANT, WILBUR N., Midland, Pa. (Rt)
SCHNELL, WILLIAM R., White Plains, N. Y.
SHERMAN, THOMAS J. F. (CAPT.), Los Angeles, Calif.
SMITH, RICHARD WENDELL (LIEUT.) San Pedro, Calif.
SMITH, W. ARTHUR, JR., Boston, Mass.
SONNINO, MARIO, Stamford, Conn.
STACK, FRANCIS E., Detroit, Mich.
STOLFO, VITO J., Akron, Ohio
STONE, J. L., Burlingame, Calif.
STRACHOVSKY, N., Erie, Pa.
THAILING, ANDREW G., South Charleston, W. Va.
THOMAS, LACY GREER (ENSIGN), Washington, D. C.